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DEVELOPING SATELLITE COMMUNICATIONS FOR PUBLIC SERVICE:

PROSPECTS IN FOUR SERVICE AREAS

by

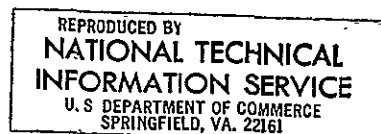
Public Service Satellite Consortium  
4040 Sorrento Valley Blvd.  
San Diego, California 92121

prepared for

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## ABSTRACT

The Public Service Satellite Consortium (PSSC), which is a growing consortium with a membership of over 80 non-profit organizations, evaluates prospects for satellite telecommunications in four areas of the public service: the U.S. health care system, elementary and secondary education, American libraries, and that sector of the public service which is concerned with the provision of continuing education to health professionals. The objective is to understand the basic requirements of these sectors, their major problems and opportunities, and the trends which implicitly will define their future course. PSSC has made a special effort to evaluate qualitatively the institutional implications of more extensive utilization of computer and telecommunications technology in these four areas of public service. Generally speaking, the milder the required institutional adjustments, the more acceptable a new service is likely to be.

After reviewing the composite requirements, PSSC attempts to identify categories of new telecommunications services which show particular promise of enhancing the productivity of the public service. The potential demand in 1982 for such services is projected under the optimistic assumptions that an appropriate satellite communication network will be available and that there will be high acceptance of the new services within the target markets. There has been no attempt to estimate how long it will take for the potential markets to mature.

This study leads to three important conclusions: First, throughout the public service there are three recurring needs: improved access, cost containment, and maintenance of quality. Appropriate application of communication satellite systems could ameliorate each of these concerns. Second, there appears to be an enormous latent demand for data communication services throughout the public service. The potential demand in 1982 to support requirements in hospital administration, library services and other information-retrieval activities, equipment maintenance, and environmental monitoring may be in excess of \$300 million a year. Third, administrative applications of data communication networks show particular promise, especially in rural areas.

NASA's proposed Public Service Communications Technology Satellite program, which would advance U.S. research interests in space communications and accelerate transfer of space technology to its useful application in the public service, could be a very worthwhile investment. For this program to result in genuine productivity gains, however, NASA will have to strengthen existing linkages with other government agencies, the aerospace industry, the common carriers, and the user community.

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# CHAPTER I

## INTRODUCTION

### A. The Age of Information

Human history has long been characterized in terms of ages, whose names reflect the state of development of a particular era: the Stone Age, the Bronze Age, the Iron Age, and so on. IBM argues in its current advertising campaign that there is now general agreement that civilization is passing from the Industrial Age to the Age of Information. This historical transition is being propelled by developments in computer and communications technology. Advanced techniques in information processing and transfer have given mankind powerful new tools which will revolutionize the fundamental process of cognition.

In the past 25 years there has been an explosion of knowledge; 90% of the people who have ever formally published are alive today. The total body of technical information is doubling every ten years, and there is reason to believe that the present exponential rate of growth will increase in the next 25 years.

What accounts for this sudden improvement in man's ability to build on the discoveries of others? His genetic capacity to learn probably has not changed appreciably in the last 300 years, which is a relatively short span of time on the evolutionary scale. But existing knowledge is now structured to permit much wider access to new information, and far more people are in a position to contribute to knowledge than in previous centuries. Thus, while mankind's innate potential to learn has changed little in the past 300 years, he has devised techniques which will allow a larger percentage of the population to approach their full potential.

There will be less emphasis in future years on rote memorization. When one needs data, one will be able to obtain it quickly and economically via a distributed information network. The skills which will permit the individual to flourish in this new era are basic: one must learn how to reason, how to ask proper questions, how to obtain relevant information, and how to communicate effectively. The dawn of the Age of Information offers stimulating opportunities for all Americans, but the challenge lies ahead. This study is intended to help the National Aeronautics and Space Administration (NASA) assess how possible new initiatives in space communications could lead to a richer harvest of the fruits of the Information Age to the public service.

To remain the most affluent society on earth, the United States must also be the most productive society. Health and education are particularly in need of productivity gains. Present preoccupation with the world-wide energy crisis masks the burden which these two service sectors are imposing on the overall economy: they are not carrying their own weight. Since 1943 health and education have accounted for an increased fraction of the gross national product. (Figure I.1) This statistic is disturbing in view of the fact that enrollment in public schools, for example, peaked in 1970-71 and has been declining ever since. Furthermore, although costs have risen, there remain great inequalities in the availability and quality of services in health care and education.

If equal access to adequate health, educational, and other social services is to be made available throughout the U.S., and if service delivery arrangements are to become more flexible, the heavy reliance on face-to-face delivery must be modified. It is inevitable that communications will play an important role in whatever organizational arrangements evolve to cope with expanding service requirements. The present budgetary squeeze on many public service agencies, while unpleasant, is making them increasingly open minded about the potential benefits of labor and cost-saving technology.

## B. Objectives

The focus of this study is on the requirements of four sectors of the public service: the U.S. health care system, elementary and secondary education, American libraries, and that sector of the public service which is concerned with the provision of continuing education to health professionals. The objective is to understand the basic missions of these sectors, their major problems and opportunities, and the trends which implicitly will define their future course. PSSC has made a special effort to evaluate qualitatively the institutional implications of more extensive utilization of computer and telecommunications technology in these four areas of the public service.

PSSC attempts to identify sectors of the public service where aggregation of a broad base of users in support of a new telecommunications service is likely. Generally speaking, the milder the required institutional adjustment, the more acceptable a new service is likely to be. But unless increased dependence on technology is almost certain to result in productivity gains, it is doubtful that public service institutions will make extensive use of any new computer or telecommunications service. Under the best of circumstances, acceptance of a new innovation will be delayed by institutional inertia and subjective reaction to the



# EXPENDITURES FOR HEALTH AND EDUCATION AS A PERCENT OF GROSS NATIONAL PRODUCT

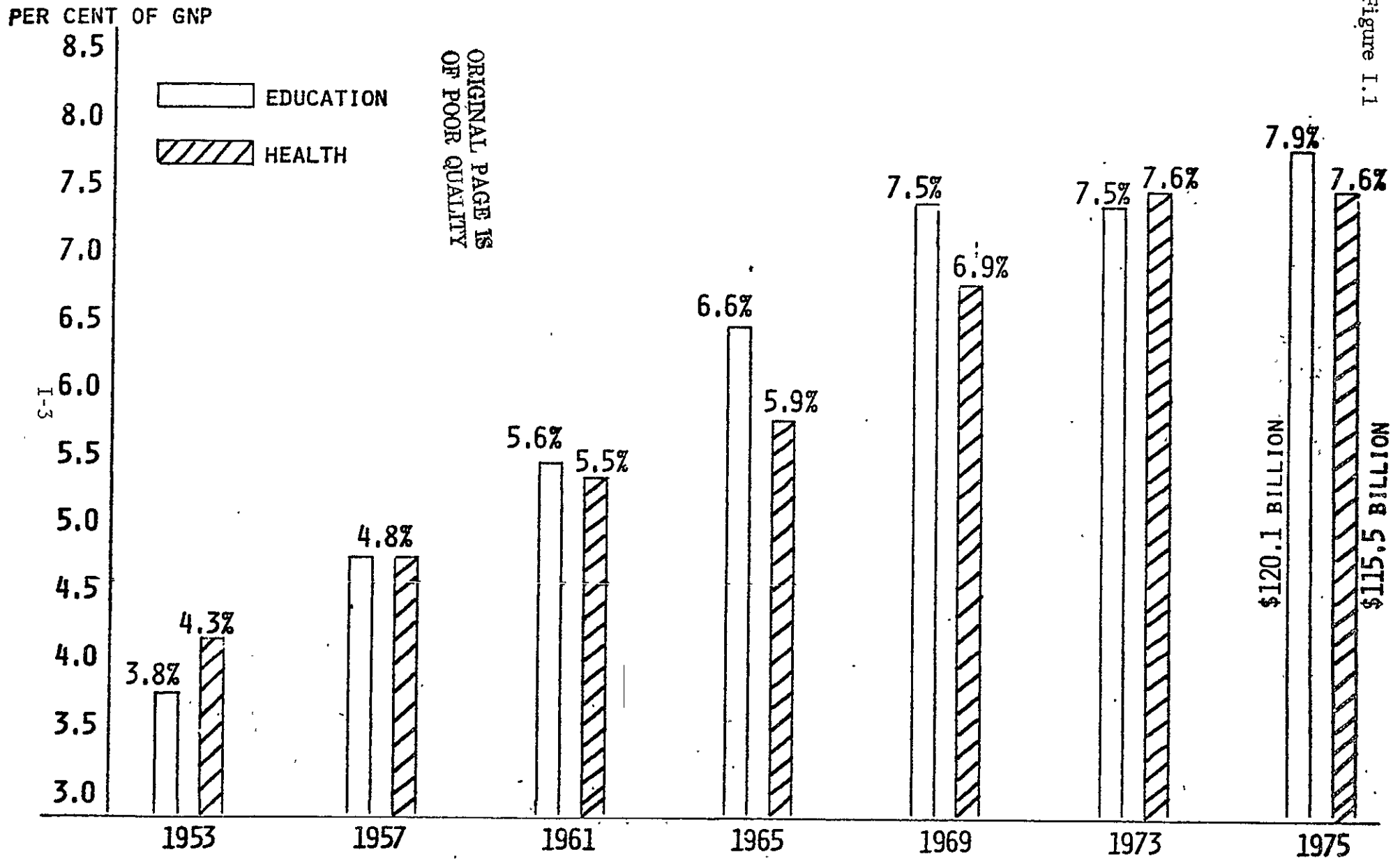


Figure I.1

SOURCE OF DATA: NATIONAL CENTER FOR EDUCATION STATISTICS, NATIONAL CENTER FOR HEALTH STATISTICS,  
COUNCIL OF ECONOMIC ADVISERS

temporary but possibly threatening perturbances which will accompany necessary re-definitions of departmental functions and individual roles.

After reviewing the composite requirements, PSSC attempts to identify categories of new telecommunications services which show particular promise of enhancing the productivity of the public service. The potential demand in 1982 for such services is projected under the optimistic assumptions that an appropriate satellite communication network will be available and that there will be high acceptance of the new services within the target markets. There has been no attempt to estimate the probable initial demand for service or the rate of acceptance. These crucial economic issues could best be analyzed via actual demonstrations of promising new services.

### C. A Role for NASA

Three recurring needs appear throughout the public service: improved access, cost containment, and maintenance of quality. Appropriate application of communication satellite systems could ameliorate each of these concerns. Indeed, low-cost communication is a prerequisite for organizational arrangements which depend upon the substitution of communication for transportation to achieve higher efficiency.

The communication satellite, which could provide distance insensitive service and flexible allocation of capacity, shows great promise of improving access to needed services and facilitating the aggregation of scarce resources across geographic regions. To achieve this promise, however, the communication satellite must be integrated with information networks which respond to genuine user requirements. Substantial reductions in the end-to-end cost of service will have to be achieved before computer-communications networks are likely to have a significant impact on the productivity of the public service.

NASA has a vital role to play in working with industry to develop new technology which will lower the cost of service and in working with users to define requirements, identify where productivity gains are likely, and aggregate uses of new information services. There are large risks associated both with applying new technology and serving emerging markets. NASA should extend its role in the development of space communications to facilitate the necessary aggregation process and to promote more effective transfer of technological developments to useful application.

In January, 1973, faced with the necessity of reducing expenditures, NASA elected to lessen its commitment to space communications R&D. It was hoped that private industry could sustain the position of preeminence which the U.S. has enjoyed in space communications. Several organizations have since evaluated the consequences of this decision and have urged NASA to re-examine its decision.<sup>1,2,3</sup>

At NASA's request, the National Research Council agreed to study the question: "Should federal research and development on satellite communications be resumed and, if so, what is the proper federal role in this field?" A Committee on Satellite Communications was formed under the auspices of the Space Applications Board. The final report of this committee, which was published in March, 1977, recommended not only that NASA implement an experimental satellite communications technology flight program but also that NASA, working with appropriate user agencies, jointly define, develop and test (including new flight demonstrations) new public service satellite communication systems.<sup>4</sup>

The task of improving public service productivity is too complex for NASA or any other single agency to accomplish alone. NASA will have to strengthen existing linkages with other government agencies, the user community, the aerospace industry, and the common carriers to perform this task in a responsible fashion. Implicit in this process must be a continuing effort on NASA's part to better understand the requirements of the constituencies it will be attempting to serve, an objective which this study is intended to support.

NASA should take the long view. It must strive to understand the basic functional objectives of the constituencies it serves and to use its resources to support R&D programs that advance the technology in the direction of the long-range public interest. Over the long term, for example, public schools will have to improve their productivity to live within presently acceptable budgetary limits. But over the short term, increased productivity is politically impossible when it means replacing school teachers with capital equipment. Similarly, over the long term, common carriers try to use the most cost-effective technology which is available to meet their service requirements. Over the short term, however, common carriers tend to resist change when it means replacing equipment which has not been fully amortized with a more efficient technology.

The Age of Information is providing opportunities which are sufficient to engage the energy and vision of all Americans. Public service users, however,

have difficulty coordinating their actions and planning for the future when the projects under consideration cross institutional boundaries. NASA leadership is necessary to obtain a proper dividend from the people's investment in space.

#### D. Areas Selected for Study

The public service is a vast sector of the American economy; health and education expenditures represent in excess of 16% of the gross national product. To obtain useful results within the eight-month time frame of this study, PSSC concentrated on service sectors where its staff and consultants were experienced and knowledgeable. The four areas selected -- health care, elementary and secondary education, libraries, and continuing education in the health professions -- span a reasonable cross section of the public service and probably could benefit significantly from increased utilization of telecommunications. These sectors do not represent the largest potential markets for public service satellite communications, however; the largest users undoubtedly will be federal and state government agencies. PSSC was not in a position to evaluate these requirements in the short time available.

A study of this nature may be approached in at least three ways. Ideally, one would evaluate the demand for particular new services. Data of this nature would have greatest utility to private industry and government. It would permit private industry to evaluate the probable return on investment of new products or services and would permit NASA to assess the costs and benefits of alternative programs in space communications. Secondly, one might focus on a particular agency, such as the Veterans Administration, and attempt to understand how it is now using telecommunications and how it should use telecommunications in the future. PSSC intends to use this approach in future studies because the detailed information which will be obtained should be extremely useful. In this preliminary study, however, PSSC elected to examine whole sectors of the economy and attempted to infer (through a combination of experience, empiricism, and intuition) what functional requirements could be aggregated and thereby form a viable market for new and innovative communication services.

## E. The Promise of Communication Satellites

Synchronous communication satellites have generic properties which make them attractive vehicles for performing certain functions:

1. Broadcasting, which involves the transfer of information from a few points of origination to many receivers, as in a TV or radio network.
2. Archiving, which arises when the spokes of the wheel wish to communicate with the hub; for example, when a group of libraries need to access a central data base, such as the Library of Congress.
3. Flexible routing. It is possible to allocate the available capacity among the possible routes in the network in an extremely flexible manner. When the demand for service is unknown or changes rapidly, this ability to aggregate requirements across an entire region will be attractive.

Most of the communication requirements which are examined in this study have one or more of the above characteristics. This is not to say that satellite communication networks should route all of the traffic which is identified. Terrestrial networks probably will provide superior service when the traffic is primarily local or when the requirement calls for extensive switching. But satellite communication will become much more attractive in the 1980s because the Space Shuttle will reduce substantially the cost of placing large payloads into synchronous orbit.

Two other technological developments have advanced the utility of information networks. Fiber optics were first perfected in the laboratory in 1975. These glass fibers provide gigahertz bandwidths with remarkably low attenuation. What the communication satellite has done for long-distance communications, the glass fiber is doing for local communications: providing inexpensive broadband transmission. Comparing the information capacity of a glass fiber with a copper wire is tantamount to comparing Niagara Falls with a garden hose. In addition to the communication satellite and glass fiber, there is a microprocessor. This device has led to an abundance of inexpensive "smart boxes," which are being used to control everything from microwave ovens to the flow of information. From a technological point of view, the prospect of a Wired Nation is now real.

Public service users could not have picked a better time in this century to organize and effectively aggregate their communication requirements. The Federal Communications Commission is encouraging competition in domestic communications, and there has been a powerful response from private industry. The communication satellite, the glass fiber, the microprocessor, and the digital computer have given public service users the means to cope successfully with the information explosion -- if they can organize effectively. An investment now in NASA's proposed Public Service Communications Technology Satellite program should return with high interest the fruits of the Information Age to the American people.

#### F. Overview of the Study

The problem of introducing innovation in public service and a discussion of some underlying factors which must be understood to deal meaningfully with the interrelationships between information networks and productivity appears in Chapter II. More detailed discussion of these same issues as they relate to particular sectors of the public service appears in Chapters III through VI. The composite new communication requirements of the sectors evaluated are summarized in a qualitative fashion in Chapter VII. Dr. James G. Potter, who edited this report and is PSSC's director of planning and analysis, was the principal author of Chapters I, II, and VII. Dr. Potter is a communications engineer who is an expert on the economics of satellite communication networks.—

Chapter III is addressed to the telecommunication requirements of the health sector, which shows high promise of near-term productivity gains. The problems and opportunities of the six levels of the U.S. health care system are examined: preventive care, primary care and emergency medical services, secondary care, tertiary care, restorative care, and continuing care. The health care system is one of the few U.S. industries where substantial investment in technological innovation has not resulted in a lower per-unit cost of production. But because hospitals now allocate approximately 10% of their operating budgets to record-keeping functions and because automated clinical apparatus can be shared, information networks may provide substantial cost savings. Dr. Thomas E. Terrill, the author of Chapter III, is vice president of the Hollywood Presbyterian Medical Center in Los Angeles, California, and a Ph.D. in hospital administration.

Elementary and secondary education potentially could achieve high productivity gains through appropriate application of information technology, but difficult organizational adjustments are required. In Chapter IV, Dr. Louis A. Bransford, PSSC's director of service development, and Ms. Kathleen King, research assistant at PSSC, attempt to identify where to enter the system and begin the necessary but elusive process of change. Possible initiatives are discussed in six alternative areas: administrative and management services, rural education, education for the handicapped, migrant education, vocational education, and multicultural/bilingual education. Federal funds are available to implement broadly-based demonstrations of new organizational procedures if agreement between participating agencies could be reached on a development plan. Dr. Bransford, who received his academic training in Special Education, is an expert on the utilization of telecommunications in education. Ms. King is completing her Masters Degree in Public Administration.

Library patrons promise to be major beneficiaries of the yield of the Information Age. The library community is becoming aware of the promise of information networks and is developing workable methods to improve the productivity of the system. The director of the Ohio College Library Center, Frederick G. Kilgour, believes that computer-communication networks can provide answers to many of the problems faced by the traditional library.

*"Libraries must look forward to supplying information to the user when and where he needs it -- an objective impossible to attain with classical library techniques ...<sup>5</sup> A computerized network can make available vast information resources to individual library users. At the same time that a network is increasing the availability of resources, it also makes possible the reduction in the rate of rise of per-unit costs to bring them into line with the rate of rise of per-unit costs in the economy as a whole."<sup>6</sup>*

The evolution of information retrieval services and the manner in which the American library community is adjusting to incorporate these developments is described in Chapter V. The principal authors of this chapter are Martha E. Williams of the University of Illinois, who is editor of the Annual Review of Information Science and Technology and is responsible for the material on information retrieval, and Dr. Ruth M. Katz of the Denver Research Institute, who is a librarian by training and an expert in the use of media within the traditional library system.

Ralph P. Christenson, M.D., director of Health Information Systems of the Mountain States Health Corporation, and Ms. King jointly authored the chapter on continuing education in the health professions. The threat of professional obsolescence looms large in the Age of Information. The life-long obligation to seek new knowledge is clearly recognized in the code of ethics of a number of occupational groups. Now that the population is growing older and the number of applicants to the undergraduate programs of colleges and universities is declining, continuing education represents the largest growth area of higher education. It is impossible to over-emphasize the diversity of demand for continuing education. To gain deeper understanding of the implicit requirements, Chapter VI focuses on the health professions generally and continuing education for physicians specifically.

Chapters III through VI emphasize the requirements of four sectors of the public service in terms of basic mission, major problems and opportunities, and related trends. The implication of these requirements in the context of communications systems engineering is discussed qualitatively in Chapter VII. The indications of this study suggest that over the near term, the largest benefits to the public service resulting from increased use of telecommunication services are likely to result from applications of low-cost, two-way data communication networks. The potential demand in 1982 to support requirements in hospital administration and clinical support, equipment maintenance, knowledge retrieval, environmental monitoring, and adult education, appears to be on the order of \$167 million a year; and the total potential demand from public service organizations is in excess of \$300 million a year. Administrative applications of data communication services show special promise. While a combination of space and terrestrial facilities should be utilized to respond to this growing requirement, in rural areas particularly satellite communication networks are likely to be cost effective.

Other recent studies of public service requirements have projected a demand in excess of 300 video circuits to support requirements of U.S. educational and health-care institutions.<sup>7,8</sup> PSSC concurs in this long-term projection but cautions that a gestation period through the 1980s probably will be necessary.

The major conclusions of this study are summarized in Chapter VIII.



## CHAPTER I

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## CHAPTER II

### FACILITATING INNOVATION IN THE PUBLIC SERVICE

#### A. The Productivity Crisis

C. Richard Jones of the Hughes Aircraft Company observed in an address at PSSC's Conference on Satellite Communications for Public Service on December 9, 1976:

*"Most Americans are aware of the growing costs of our public services, but they are generally unaware of the rate of growth. The federal outlays in 1967, 1972, and 1977 for specific services (Figure II.1) dramatize the rate of growth: education, training, employment, and social service outlays have grown by nearly a factor of three; health outlays by a factor of five; law enforcement and justice outlays by a factor of five; and veterans benefits and services outlays by a factor of three. By contrast, the federal investment in general science, space, and technology has been reduced to 70% of the 1967 outlay. This picture is repeated at the state and local level. Even at such an expenditure level, many Americans are justly dissatisfied with the services, and the nation cannot sustain this cost growth in future years. The public service sector must both improve service and reduce costs."*

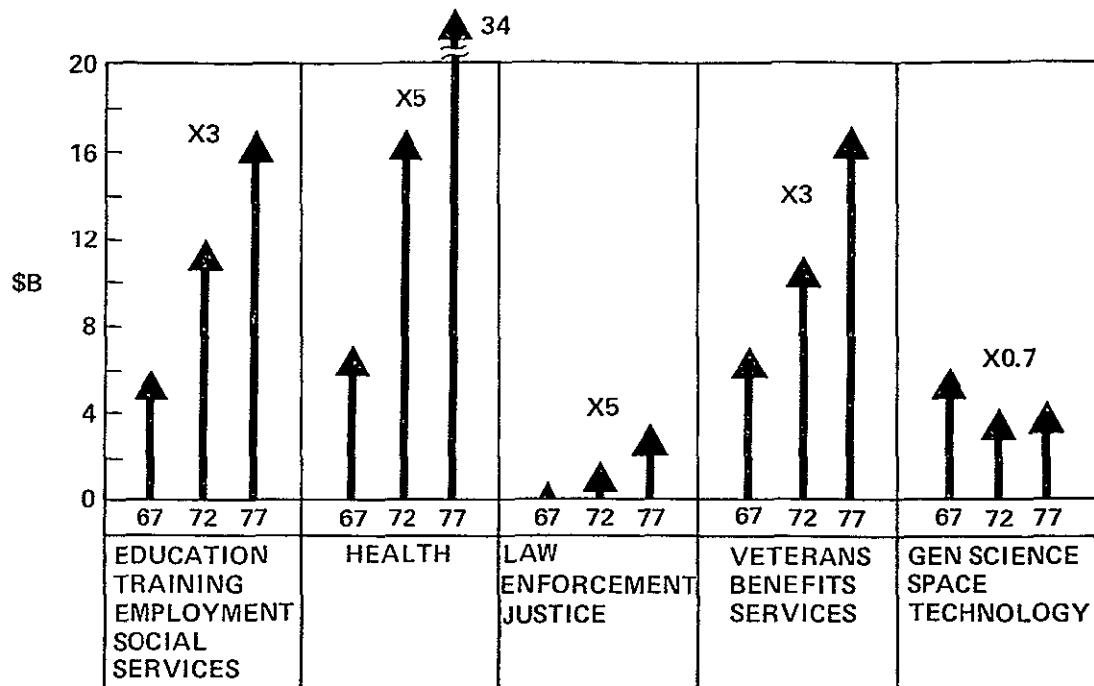


FIGURE II.1 : FEDERAL OUTLAYS TO SELECTED PUBLIC SERVICES  
(1965 to 1977)

Figures taken from The Budget of the United States Government Fiscal Year 1977. Table 19, pp. 360-365.

Consider the health services industry. Since 1950 the Consumer Price Index has increased by 98%, but hospital costs have increased by 600%.<sup>1</sup> In the period between 1960 and 1973, nonpayroll expenses rose from 37% of the hospital operating budget to 44% of the total.<sup>2</sup> Curiously enough, at this same time the number of hospital personnel rose from 2.26 per patient to 3.15!<sup>3</sup> Investments in clinical technology have been made with apparent disregard for the cost of service to the patient. (Chapter III, page III-40.)

Public school enrollment peaked at 46 million in 1970-71 and has been steadily declining since. Presently, it is down by 1.7 million; and by 1983 it will be down almost 6 million.<sup>4</sup> Nonetheless, education has been spending an increasing fraction of the gross national product during this period.

A theme which recurs throughout this report is the need to improve access, control costs, and maintain the quality of service. In time the United States may be overwhelmed by the extravagant, albeit well meaning, tendencies of the public service. Awareness of the imperative need for productivity gains is increasing. The Carter Administration has proposed a lid on the rate of increase of hospital expenditures; and school systems throughout the country are facing increasingly critical taxpayers.<sup>5</sup>

But the underlying problems are not easily understood, much less overcome. How does one measure productivity in education or in health care? Is there agreement on the basic objectives of public education in the U.S.? PSSC is of the opinion that there is a greater need for institutional R&D than technological R&D. A short commentary regarding past attempts to accelerate technology transfer to the public service may be appropriate.

#### B. Overview of the Problem<sup>6</sup>

It has become commonplace to say that technology runs ahead of our ability to use it. This seems true even when many responsible people agree that a given technological development holds real promise for rendering service better, or at less cost, or both. Much has been written about the desirability of substituting communication for transportation to conserve energy, decentralize industry, improve the delivery of social services, and enhance the quality of life. A number of federally supported experiments have explored the utility of delivering health care, education, and other public services through the medium of satellites or cable. In view of the high promise of such innovations, the reality of their actual use is all the more disappointing.

In the United States most major public services, including education, health care, library services, and even public safety, are fundamentally local. Most Americans believe in the local school district, the separate university, the individual medical practice, the community hospital, and the local police and fire service. While some state and federal regulations apply to aspects of these services, the distant bureaucracy is

often resented as a deviation from fundamental principals: basic management begins at home. Most Americans believe that this decentralized approach -- for all of its redundancies, presumed inefficiencies, uneven quality, and regional mismatches -- is the best course for the society. We don't want Big Brother teaching our children or a brooding police presence looking over our shoulders.

One consequence is that there is no such thing as an American Education System or an American Health Services System.

Along with the strengths of this arrangement, however, there is a dilemma. The diffusion of control makes it difficult to make decisions which cross jurisdictional boundaries. And if any enterprise is to apply a new development broadly and systematically, it must do so consciously; there must be a decision-making structure able to make it so. But education, for example, has no such structure. Basic decisions are made at the level of the school district or the individual university campus. The largest effective decision-making unit is the state. Federal participation totals about 8% of the education budget,<sup>7</sup> and with few exceptions federal agencies are constrained by custom, law, and the political process from exerting substantial leverage on education in any monolithic sense.

Thus, there exists a classic marketing problem. An administrator in education-- at whatever level he works -- is likely to spend very little time thinking about future communication requirements, because he knows that his sphere of influence is too small to affect the whole and his mandated budget processes discourage the attempt. The supplier of communication services, though his intuition may speak to him about multi-million dollar markets, knows that there is no real handle on the situation. The notion of an education market is an illusion.

The result, then, is a dampening effect on innovation. Because of a diffuse decision-making structure, it is hard for either potential buyers or potential sellers to assess demand for relatively complex services. The seller's response to this situation is to shape his product or service to markets in which he can identify specific buyers. He sells

hard to these identifiable customers, and he markets the same products as best he can to the public service.

Most individual public service organizations cannot now afford access to the sophisticated information systems presently (or soon to become) available. If cost-effective information networks which are responsive to individual user requirements are to become operational, it will be necessary to aggregate sufficient numbers of users to allow effective negotiations for core service requirements.

The Public Service Satellite Consortium (PPSC) was created by NASA, HEW, and various public service organizations to provide an acceptable mechanism for aggregating user requirements and inducing qualified suppliers to respond to these requirements. The Consortium now has over 80 members and expects to expand substantially in the next year. A review of the membership list and Board of Directors reveals that a broad cross section of public service organizations already are involved. (Appendices II-A and II-B)

### C. Elements of Successful Aggregation<sup>8</sup>

Health and education can afford advanced telecommunications. Having composite annual expenditures in excess of 16% of the gross national product, they can (theoretically, at least) afford just about anything. How does one go about gaining a reasonable consensus for action on a major capital investment affecting this service sector? How should one apply the lessons which have been learned from previous attempts to introduce cost-saving technology to the public service?

It is important to recognize the realities of budgeting, organization, and politics in public service agencies. It will be necessary to provide enough time -- and a firm enough track -- for a difficult process to work. Actual times will vary with situations, but five years would not be excessive in some cases. Generally speaking, it will be necessary to provide a low-budget, low-threat entry point, along with a well reasoned set of milestones. It will be necessary to establish formal linkages between participating government agencies, user institutions, the aerospace industry, and commercial

common carriers. If agreed criteria are met at each succeeding milestone, the parties are mutually committed to move toward the next. At the end of this process, the long-run financial and operational arrangements should fall smoothly into place.

There is, however, a trap in considering funded experiments and demonstrations. They become unique objects for study, exempt from restrictions of the real world. It is essential that the proposed service initiatives be rooted firmly in reality. They are not experiments, but first-of-a-kind operations. Their potential social value and their unproved nature justify special nurturing, but from the outset they should be seen as permanent operational enterprises. There will be bugs to work out and studies to conduct; but each decision should be aimed toward the health of the long-run enterprise, and not toward the purity of a research design.

A strong institutional base in support of the service package, complete with a known complement of strong, committed people, is a vital element of the innovation process. Too many demonstrations and experiments collapse with the termination of the grant because the grant, in effect, was the organizing principle. A case in point was the educational experiment which was conducted by the Federation of Rocky Mountain States on NASA's ATS-6 satellite.<sup>9</sup> When ATS-6 went to India, the service simply stopped. By contrast, the health experiments conducted on ATS-6 in Alaska proved to have more lasting impact.<sup>10</sup> The Alaska Native Health Service kept the momentum going in the field of medical care. Within the State government, there was direct transfer from the ATS-6 project to the intrastate communications network which is operated by RCA Alascom through the mechanism of the Governor's Office of Telecommunications. The Governor's telecommunications staff, who were principal agents of change, moved the program without a break in continuity from an experimental to an operational status.

Entrepreneurial initiative on the part of the proponents of a new service will be required to establish a broad base of support. A consequence of this pioneering fervor in most cases will be a blurring of the lines between commercial and public service activity; generally both sectors will have to benefit from the new service or it will not become economically viable.

#### D. The Federal Role

In the absence of federal leadership, it is unlikely that public service organizations will be able to overcome their historic tendency to plan autonomously and build cottage industries. The federal government is the major underwriter of the public service, and its share of the burden is increasing. In the last 15 years, for example, the federal contribution to health care service increased from 25% to 40% of total expenditures.<sup>11</sup> This existing commitment mandates concern for improved productivity. Only the federal government is in a position to coordinate needed change.

The recent reorganization of the Department of Health, Education, and Welfare illustrates the Carter Administration's concern with costs and management. (Chaper III, pp. III-32 to III-33.) With this restructuring will come increasing pressure to aggregate requirements, share resources, and reduce costs. A joint effort involving NASA and other federal agencies which have direct responsibility for applications within particular areas of the public service will be necessary for the proposed Public Service Communications Technology Satellite program to succeed.

Some individuals having knowledge of the operating practices of public service will smile cynically if NASA elects to embark on a broadly-based program to achieve productivity gains. For the federal government to turn away from this challenge at this time, however, would not be benign neglect; it would be an abdication of responsibility.



# Public Service Satellite Consortium

## APPENDIX II.A.

September, 1977.

### MEMBERSHIP

Alabama ETV Commission  
Alaska, State of..  
All Indian Pueblo Council Inc.  
Aloha Project  
American Academy of Orthopaedic Surgeons  
American Association of School Administrators  
American College of Physicians  
American College of Radiology  
American Dietetic Association  
American Hospital Association  
American Law Institute - American Bar Association  
Committee on Continuing Professional Education  
American Library Association  
Appalachian Educational Satellite Project  
Aspen Institute

Bilingual Children's Television, Inc.  
Brigham Young University

California Public Broadcasting Commission  
California Innovation Group Inc.  
California State University & Colleges  
Catholic Television Network  
Central Educational Network  
Committee on Institutional Cooperation  
Community Television of Southern California, KCET  
Corporation for Public Broadcasting  
Council for Exceptional Children

Appendix II. A. (cont.)

PSSC Membership  
September, 1977

Denver Research Institute

Education Commission of the States  
Education Development Center, Inc.  
Exxon Education Foundation

Federation of Rocky Mountain States Inc.  
Forum for the Advancement of Students in Science & Technology Inc.

Georgia Institute of Technology

Hahnemann Medical College & Hospital of Philadelphia

Illinois, State of ..  
Division of Telecommunications  
Indiana Higher Education Telecommunication System  
Indiana University School of Medicine,  
Medical Education Resources Program.

Joint Council on Educational Telecommunications

Maryland Center for Public Broadcasting  
Medical Care Development Inc.  
Medical University of South Carolina  
Miami-Dade Community College District  
Minnesota Cable Communications Board  
Mississippi Authority for ETV  
Modesto Junior College  
Monsour Medical Foundation  
Mountain States Health Corporation ..

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National Education Association  
National Eye Foundation, Inc.  
National Public Radio  
North Dakota Educational Broadcasting Council

Ohio College Library Center  
Ohio State University  
Ohio Educational Television Network Commission  
Ontario Educational Communications Authority  
Oregon State Board of Higher Education

Public Broadcasting Service  
Public Communication Foundation for North Texas  
Public Interest Satellite Association (PISA)

Radio & Television Commission  
Southern Baptist Convention  
Rocky Mountain Corporation for Public Broadcasting

St. Louis Educational Television Commission  
San Diego County Department of Education  
San Diego State University  
Satellite Library Information Network (SALINET)  
South Carolina Educational Television Network  
Southern Educational Communications Association  
Stanford University  
Communications Satellite Planning Center

The Association for Graduate Education & Research of North Texas (TAGER)

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United Methodist Board of Discipleship  
United States Catholic Conference  
University of Alabama in Birmingham  
University of California  
University of Colorado Medical School,  
Department of Anatomy  
University of Hawaii  
University of Maine at Farmington  
University of Mid-America  
University of North Dakota  
University of Southern California  
University of Wisconsin - Stevens Point  
Utah State University

Virginia Public Telecommunications Council

Western Interstate Commission for Higher Education (WICHE)  
Western Michigan University

*II-11*

# Public Service Satellite Consortium

## APPENDIX II.B.

### BOARD OF DIRECTORS

1977

#### Chairman

HON. H. REX LEE

Adjunct Professor, San Diego State University  
Public Service Satellite Consortium  
4040 Sorrento Valley Boulevard  
San Diego, California 92121

#### Vice Chairman

DONALD R. QUAYLE

Senior Vice President  
Corporation for Public Broadcasting  
1111 Sixteenth Street, N.W.  
Washington, D.C. 20036

#### Secretary

FRANK W. NORWOOD

Executive Director  
Joint Council on Educational Telecommunications  
1126 Sixteenth Street, N.W.  
Washington, D.C. 20036

PETER G. BOWERS

General Manager, Operations  
Ontario Educational Communications Authority  
P.O. Box 200, Station Q  
Toronto, Ontario M4T 2T1, Canada

E. WAYNE BUNDY

Executive Director  
Rocky Mountain Corporation for Public Broadcasting  
1603 Sigma Chi Road, N.E.  
Albuquerque, New Mexico 87106

HON. JACK M. CAMPBELL

President  
Federation of Rocky Mountain States  
Campbell, Bingaman and Black  
P.O. Box 2208  
Santa Fe, New Mexico 87501

DOUGLASS CATER

Aspen Institute  
c/o Observer International, Inc.  
8 St. Andrew's Hill  
London EC4V 5JA, England

Appendix II.B. (cont.)

RALPH P. CHRISTENSON, M.D.  
Mountain States Health Corporation  
P.O. Box 19017  
Portland, Oregon 97219

DAVID L. CRIPPENS  
Vice President, Educational Projects  
Community Television of Southern California  
4401 Sunset Boulevard  
Los Angeles, California 90027

REV. MONSIGNOR PIERRE DU MAINE  
President  
Catholic Television Network  
443 Church Street  
San Francisco, California 94114

CHARLES V. HECK, M.D.  
Executive Director  
American Academy of Orthopaedic Surgeons  
430 North Michigan Avenue  
Chicago, Illinois 60611

PRESLEY D. HOLMES  
11909 Tallwood Court  
Potomac, Maryland 20854

F. LEE MORRIS  
Executive Director  
Mississippi Authority for ETV  
P.O. Drawer 1101  
Jackson, Mississippi 39205

WILLIAM T. REED  
Director, Station Relations  
Public Broadcasting Service  
475 L'Enfant Plaza West, S.W.  
Washington, D.C. 20024

JANE G. RICHARDS  
Executive Director  
Indiana Higher Education Telecommunication System  
1100 West Michigan Street  
Indianapolis, Indiana 46202

EDWARD C. ROSENOW, JR., M.D.  
Executive Vice President  
American College of Physicians  
4200 Pine Street  
Philadelphia, Pennsylvania 19104

SIDNEY TISHLER  
Director, Telecommunications Office  
Maryland Center for Public Broadcasting  
Owings Mills, Maryland 21117

ROBERT M. WALP  
Director, Office of Telecommunications  
State of Alaska  
338 Denali Street  
Anchorage, Alaska 99501

ROBERT WEDGEWORTH  
Executive Director  
American Library Association  
50 East Huron Street  
Chicago, Illinois 60611

HAROLD E. WIGREN  
Telecommunications Specialist  
National Education Association  
1201 Sixteenth Street, N.W.  
Washington, D.C. 20036

ELIZABETH L. YOUNG  
Director, Telecommunications Center  
Ohio State University  
2400 Olentangy River Road  
Columbus, Ohio 43210

## CHAPTER II

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## CHAPTER III

### PROSPECTS FOR ADVANCED TELECOMMUNICATIONS IN THE HEALTH INDUSTRY

#### A. Introduction

The health-services industry is a major sector of the U.S. economy, accounting for over eight percent of the gross national product. This industry will continue to grow both in terms of resources consumed and services rendered despite serious problems pertaining to access to patient care, skyrocketing costs, and quality of service. Its continued growth and improvement will come about through the reorganization of disparate, autonomous institutional providers. Modern telecommunications shows promise of accelerating this evolutionary process.

The concept of a health system brings to mind an organized group of people and machines with consistent objectives. This image is inappropriate. To understand the problems, constraints, and opportunities now facing the health sector, the concepts to remember are pluralism, free enterprise, and variability. To quote the Health Resources Administration:

*"Health care in the United States is currently delivered by a wide spectrum of providers. Although there is some informal cooperation, these various providers are not linked together in any systematic way. They operate independently and autonomously, each being responsible for only a small portion of what might be called the 'total care' of the patient. As a result, patients may receive excellent care for particular health problems, but gaps in meeting their needs can occur because of inadequate coordination among the kaleidoscope of health care providers. The system gives high priority to acute care and pays little heed to the other ends of the spectrum, preventive care and continuing care."*<sup>1</sup>

#### B. Trends in Health Care

The last 25 years have witnessed a phenomenal growth in health expenditures; the portion of the gross national product which is committed to the purchase of health care has doubled since 1953.\* This expansion

\*Fig. I.1, p. I-3

has been the result of population growth, new medical technology, increased medical manpower, and a dramatic shift in the role of the federal government with regard to the financing of health services. The health industry is now the second largest in the nation, spending in excess of \$132 billion annually. Critics of the industry accuse its leaders of fostering a "non-system" of health care, composed of autonomous economic units which are costly and unnecessarily duplicative.

As a major public service industry, its support stems from local communities that have established institutions designed to serve local needs. These institutions -- hospitals, nursing homes, medical clinics and health associations -- have grown as the communities have grown. Some hospitals can trace their history of community support back more than 150 years. Many of our nation's hospitals were created by citizen leaders who were concerned about meeting local community health needs of the poor and destitute. As advances were made in patient therapy, safety, and medical quality, these early hospitals modified their mission to include service to patients from the middle and upper classes. As a result, large investments of philanthropic wealth were made in the capital sector of the hospital economy in these early years. This further solidified the autonomy of these institutions and helped to create a system of free-standing public service institutions operated by and for local communities with strong social foundations.

The recent explosion in medical technology has increased the public's expectations of its health institutions and has brought pressure upon its physicians and administrators to keep pace with these recent technological developments. This new technology is expensive. The availability of philanthropic support for the purchase of major capital items has diminished relative to the total needs of the institutions. Thus, the pressure on capital markets has increased.

The increasing participation by the federal government with regard to the payment for health services for the elderly and poor has led to an increase in regulation of our nation's health institutions. The

principal areas of concern are access, cost, and quality. In the central city and in rural America there are disturbing barriers to adequate health care; costs for health care are currently rising at twice the rate for all other items, and malpractice premiums have tripled in less than two years.

Access to health care in the United States is directly related to the patient's ability to pay and his geographic location. Recent federal involvement in financing health services for the medically indigent, aged and victims of particular categorical diseases has tended to relieve some of the disparities in providing health services. However, there remain major areas of unmet needs in certain urban ghettos and almost all of the nation's rural regions. Seventy percent of the traffic fatalities in the U.S. occur in rural areas, where only 20% of the population resides. The fatality rate resulting from coronary infarctions is twice as high in rural hospitals.

As dollar resources become more scarce and federal regulation increases, the aggregation of resources, both fiscal and technological, is becoming more attractive to the consumer as well as the provider of health services. The advent of telecommunications technology and its application to medicine and health services may stimulate this developing trend. Some of the more important trends which suggest possible areas for productive application of information technology are as follows:

1. Productivity gains in the health industry have not been commensurate with its staggering rate of inflation.

Whereas the Consumer Price Index has increased by 98% since 1950, hospital costs have increased by 600%.<sup>2</sup> The current emphasis on clinical technology has not increased productivity; on the contrary, it has created more specialization and increased the need for additional personnel.<sup>3</sup> Physician productivity, as measured by patient visits, has remained constant for 20 years.<sup>4,5</sup>

2. Demand for health care will continue to increase.

Changing age distribution of the population (declining birth rates and advancing life expectancy) is creating increasing demand for health services, due to the fact that older age groups need and use more medical care.<sup>6,7,8</sup>

3. Health care is becoming more and more institutionalized.

The knowledge and technology explosion is creating greater dependence by physicians on high technology and educational support mechanisms provided by the hospital.<sup>9,10</sup>

4. The federal government will soon be the largest single purchaser of health services.

In the last 15 years the federal government has increased its participation in the purchase of services from 25% to 40%.<sup>11</sup>

5. Continued growth in technology and cost control regulation by state and federal governments will bring about increasing aggregation of hospitals and related institutions.

The most rapidly developing phenomenon in the management of health services is the growing trend toward cooperative ventures and corporate structures.<sup>12,13,14,15,16</sup>

### C. Major Problems and Opportunities in the Health Care System

#### 1. Preventive Health Care

The six levels which form the U.S. health care delivery system are described in Appendix III.A. The present health care system emphasizes curative medicine. Preventive care is the least glamorous, most underfunded, and weakest part of the U.S. health care system. It is a rare physician or hospital who makes a significant commitment to preventive medicine; there is now little economic incentive to do so.

There are some institutions, of course, which do provide preventive health services: school health programs, well baby clinics, family planning clinics, poison information and control centers, and various governmentally supported programs such as those of the Environmental

Protection Agency, the Occupational Safety and Health Administration, and the National Center for Disease Control. But the most effective means of delivering preventive medicine is in large doses to mass audiences. Individualized care is not nearly so important in prevention as it is in the other levels of medicine. There is widespread agreement that *"the largest gains in economy, longevity, and quality of life will come from the prevention of disease rather than intervention after the damage of disease has been done."*<sup>17</sup> Professor Sherman of Harvard University goes on to note that conventional health education seems to have little effect, but that electronic media shows promise of effecting behavior change.

*"When television was forced to give as much time to the anti-cigarette smoking campaigns as was given to the sales of cigarettes, the sales of tobacco fell for the first time; tobacco sales recovered rapidly when tobacco advertisers relinquished television as an advertising medium and thereby took the platform from under the anti-cigarette campaigns."*<sup>18</sup>

To improve access to preventive care, the mentality and modus operandi of the health provider will have to change. By aggressively seeking out effective methods of delivering the information and following through to insure modification of behavior (rather than relying on "come and get it" medicine) the provider will begin to meet what many regard as his obligation to society to upgrade health standards by preventing disease.

## 2. Primary Care

The need for primary care, the early detection and routine treatment of health problems, is what attracts most people to the system. A variety of institutions provide primary care: a physician practicing independently or in a group, a medical clinic, a hospital outpatient facility or emergency room, a neighborhood health center, a community mental health center, a migrant health center, an industrial health facility, or a school or college health unit. The critical weakness of this sector of the health system is the passive nature of the provider. Currently, the only health professional who routinely reminds patients to come in for periodic prophylaxis is the dentist. Physicians seem to think that a similar effort on their part would be unethical.

This passive attitude may be changing due to the development of Health Maintenance Organizations (HMOs) modeled after the Kaiser-Permanente and Harvard Community Health Plans. These systems are structured to provide preventive medicine rather than curative medicine. There is an economic incentive to maintain the health of the patient and to avoid where possible the institutionalization of the patient for curative and/or restorative services. Critics of this approach point out that in some instances the patient is not hospitalized as rapidly as might be called for and that the patient does not have the ability to establish a patient/physician relationship.

At the core of the debate is the fundamental issue of patient responsibility and provider responsibility. The HMO-type organization tends to assume that the provider has a responsibility to counsel the patient about his health habits, his life-style, and options for maintaining good health. Until recently the major burden of responsibility has been placed on the patient, not the provider.

Despite the apparent attractiveness of the HMO model, it has not developed rapidly. Prepaid group practice systems of medicine have been available for over 30 years. As the knowledge explosion continues, however, dependence upon institutionally based medical service is increasing, and the federal government is encouraging the growth of Health Maintenance Organizations and other institutionally based systems of medicine.

There has been a dramatic shift in the number of institutional or hospital based physicians providing patient care. Although the total number of physicians grew by more than 70% between 1950 and 1975, the number of office based physicians in patient care declined from 108 per 100,000 population in 1950 to 96 in 1973.<sup>19</sup> The development of institutionally based practice of medicine is a reflection of the fact that a growing percentage of patients are entering the health care system through a hospital facility such as an outpatient department or an emergency room rather than a physician's office. The reasons for this shift are complex:

1. Physicians refer patients to hospitals for outpatient care because the hospital has equipment which is unavailable in the average doctor's office.

2. Most hospital emergency rooms are routinely open 24 hours a day.<sup>20</sup>
3. There is a shortage of physicians in the inner city and in rural America.
4. In this highly mobile era, an institution such as a hospital is often easier to locate than an individual physician. This is particularly true for the medically indigent and poor.<sup>21</sup>

There are those who would argue that primary care now provided in hospitals should instead be delivered in local community health facilities, linked in some fashion with hospitals to which patients with more serious medical problems could be referred.<sup>22</sup> The development of the neighborhood health center is a reflection of this trend. The critical weakness of most neighborhood health centers is that they do not have adequate ties to larger, more sophisticated providers. There is unnecessary duplication of administrative services and, at present, a great dependence on the socio-political climate in Washington.

In rural regions of the country, the development of the community health center may improve delivery of primary health services. The same caveats hold, however: these organizations must develop linkages to nearby community hospitals in order to improve the quality of service and reduce the overhead costs.

The demand for ambulatory medical care may rise very significantly with the advent of national health insurance. This will be due in part to the actions of the patient who is seeking reassurance from the provider regarding his health. Dr. Sidney Garfield has identified these patients as the "worried well."<sup>23</sup> It is currently estimated that only one person in three who is actually sick seeks the advice and counsel of a physician. If one removes the economic constraint, the demand for service probably will escalate astronomically.

The Harvard Community Health Plan in Boston, Massachusetts, has developed a system in which the concerned patient calls the provider institution. The telephone calls are answered by trained providers who have computerized access to the complete medical record of the patient.

Reassurance or highly targeted medical advice can be given more safely with access to the patient's medical record beside the provider's telephone. The telephone can be staffed at all hours to provide such reassurance or to give further advice on how to proceed for care. Furthermore, such an institutionalized system makes it possible to follow up on such calls to insure that the condition which provoked the inquiry has subsided or has been treated.<sup>24,25</sup> The advantage of this type of system is that it does not burden the physician with "routine" problems presented by the "worried well." The support mechanisms provided the patient are usually non-physicians who can make therapeutic decisions where appropriate (such as the nurse practitioner, Medex, or other physician extender) or decide that the patient requires more sophisticated medical help. Those systems currently in operation can handle between 50% and 60% of all "walk in" visits and a significant fraction of appointment visits dealing with chronic diseases, well baby care, pregnancy, venereal disease episodes, and other non-life threatening situations.<sup>26</sup>

Other examples of the use of telecommunications to support primary care services include television consultation on ambulatory problems between a nurse and a physician, the transmission of electrocardiograms by telephone to reduce travel by the patient or the practitioner, the remote reading of radiographic film by radiologists, and the provision of information to the "worried well" via prerecorded dial-a-tape services where an operator installs a desired educational tape on request.

### 3. Emergency Medical Services Systems (Urgent Primary Care)

Statutory authority to improve emergency care is provided in the Emergency Medical Services Systems Act of 1973 (Public Law 93-154). This law established a federal program within the Department of Health, Education and Welfare to assist communities to plan, establish, and expand emergency medical services systems capable of providing adequate and effective services to anyone in need of emergency care. The EMS Systems



Act does not set forth a master plan for a monolithic system. Rather, local control is encouraged. Each community is expected to identify its own needs and choose its own methods for providing coordinated emergency care services; the federal role is to furnish financial and technical assistance to help the community meet its objectives. The emergency care problems of rural areas, and of localities with marked population fluctuation, are matters of particular concern. Training of personnel for various levels of activities is also included. The Act places particular emphasis on the need to evaluate the effectiveness of emergency services provided.

Although the death rate from accidents is lower today than it was in 1950, it is still the fourth leading cause of death in the nation. Further, the rate of injuries from accidents has climbed considerably since 1966. The rate of injuries occurring on the job has fallen, partly because of the diminishing proportion of our population in blue collar employment and partly because of higher safety standards being enforced in our factories and mines. However, home injury rates have risen since 1966, presumably because of the growing complexity of apparatus found in modern homes.

The death rate from automobile accidents -- deaths per 100,000 population -- has risen steadily since 1960; but the fatality rates -- deaths per 100,000 vehicle miles -- dropped from 5.7 in 1966 to 4.2 in 1973, a decrease of 26%.<sup>27</sup> The incidence of disabling injuries from auto accidents has also shown a similar decline. It is believed that these decreases are due not to improved medical care, however, but to safer automobiles, better road signs, law enforcement, driver training, etc. In any event, the growth of emergency medical services systems has been stimulated by federal funding and is now a major component of the primary health care system in the United States. It is also a major user of telecommunications services.

Although the majority of this nation's population lives in urban areas (slightly more than 97% live less than one hour's drive from an institutional facility), the majority of highway fatalities occur in rural areas. Rural roads and highways are the sites for about seven out of every ten

traffic accidents. The fatalities include both rural and urban residents who often die, not because of the irreversible severity of their injuries, but because care is inadequate and not immediately available.

Within the eight Rocky Mountain states of Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona and New Mexico, emergency medical care becomes even more critical because of the vast distances between communities, hospitals, physicians and emergency medical technicians. The aforementioned states cover one-third of the area of the contiguous 48 states, with only four percent of the total population. This creates diseconomies of scale in most service areas. Similar areas of the country, such as Maine and Appalachia, are struggling to deal with the same diseconomies of scale and yet provide effective emergency medical services.

Programs to train emergency medical technicians are being provided in every state of the nation and, at last estimate, there are now over 50,000 certificated technicians. The training and certification of an EMT is currently conducted with great difficulty due to distance, terrain, lack of trainers in remote rural areas, and the lack of appropriate hospital emergency room situations. In order to provide a cadre of emergency medical technicians, the thrust by individual state emergency medical service units for the past several years has been to train new technicians through the utilization of an eight-hour basic EMT course sponsored and developed by the Department of Transportation.

Basic training is not enough. In addition to training new EMTs, there is a requirement for the retraining, updating, and recertifying of individual EMTs between the period of 12 and 36 months after their original certification. There are an estimated 25,000 EMTs now eligible for and requiring a refresher course. Recertification is aimed at securely establishing the EMTs as a capable, well-qualified, on-the-spot resource for both urban and rural areas.

There is a critical national need for training and refreshing emergency medical technicians which is not now being met due to the emphasis of current state emergency medical service programs, time available to staff,

distance, geography, sparsity of population, and a lack of trainers for remote areas.

One of the more successful demonstration projects conducted by the Federation of Rocky Mountain States under a grant from the United States Department of Health, Education, and Welfare utilized the NASA ATS-6 satellite to broadcast a refresher training program to forty-seven isolated rural communities and three public broadcasting stations in eight Rocky Mountain states. The goal of the project was to demonstrate the satellite's ability to reach remote rural areas with cost-effective educational health programming. The program was developed by the Mountain States Health Corporation in cooperation with the Federation of Rocky Mountain States, and was supported by the Robert Wood Johnson Foundation. Results of the evaluation and informal feedback from key interest groups around the nation have strengthened the case for combining satellite telecommunications technology and health programming. In the words of Dr. Thomas E. Terrill, project director, *"the combination holds great promise for cost-effective, high-quality applications for rural health systems improvement."*<sup>28</sup>

In addition to the applications of satellite-based telecommunications service for educational programming in emergency medical services, there is a great potential for effective implementation of satellite-based telecommunications among ambulance units and their support facilities. Current frequency modulation (FM) systems operate in a "line of sight" mode. In rural regions of the nation, mountainous terrain makes the implementation of microwave, FM systems exceptionally expensive and usually inadequate. In large urban areas with high building densities, similar problems occur. The availability of dedicated channels to serve emergency medical service units in urban and rural areas supported by satellite telecommunications would respond to a genuine need. In fact, discussions with the eight Rocky Mountain states' EMS directors indicates that the service would be utilized instantly if it were made available.

#### 4. Secondary and Tertiary Health Services

*"The patient requiring more than routine treatment or diagnosis is referred by his doctor (or some other primary care provider) to a hospital that has more elaborate equipment than is available in the doctor's office. Secondary care (or acute care) can be provided in either the community or a teaching hospital, but tertiary care -- care requiring even more specialized facilities and staff than secondary care -- is generally provided in a teaching hospital or a specialty hospital."*<sup>29</sup>

More than 7,000 hospitals in 1975 provided approximately 1.4 million beds to which there were over 36 million admissions. These hospitals have capital assets exceeding \$57 billion, and annual expenditures of over \$55.4 billion.

It is difficult to distinguish between those institutions (hospitals) which only provide secondary care and those which also provide tertiary care. Teaching hospitals generally provide both secondary and tertiary care, whereas most community hospitals limit themselves to providing secondary care. Community hospitals tend to serve a relatively limited geographic area, while tertiary facilities are referral centers which serve a wide geographic base in order to utilize their highly specialized facilities economically and effectively.

*"Secondary and tertiary care has been the biggest growth area in the United States health care system, in part because of the better coverage of this care by health insurance, in part because of the funds pouring into research and hospital construction, in part because of the new medical technology, and in part because of doctors' great interest in this level of care.--- The modern hospital, the elaborately equipped 'workshop' of increasingly specialized doctors, is a far cry from the hospital of a century ago, which was little more than a hospice where the poor went to die."*<sup>30</sup>

Medical economists now suspect that the comingling of secondary and tertiary care often leads to inefficient delivery of both services. That is, teaching institutions with high overhead should not treat patients having simple maladies; and community hospitals should not install

specialized facilities which will be underutilized. Regulations which delineate specific services for which institutions can be reimbursed are curbing the historical tendency of hospitals to build autonomous empires. Federal and state regulators are beginning to refuse to reimburse fully a teaching hospital which provides secondary services,<sup>31</sup> and state licensing agencies are beginning to reject applications to build specialized facilities in community or secondary hospitals.

This delineation of reimbursable service categories is intended to consolidate health care delivery within a geographic area. The availability of low cost telecommunications service to provide both clinical and managerial support to those emerging hospital networks is a prerequisite for efficient regional health systems.

#### 5. Restorative Care

Once the patient who has been receiving either secondary or tertiary care reaches the point in his therapy where he no longer needs the intensive medical and nursing services provided in the acute care facility, he is usually ready for discharge. However, he may not have reached the point where he is able to care for himself at home. To fill the gap between acute care and home care, an increasing number of restorative care facilities are being developed. These intermediate care facilities provide a lesser degree of nursing and medical care than an acute care facility. They have several advantages:

- .. They are less costly to operate.
- .. They often provide better care for convalescing patients.
- .. Patients in the convalescent stage may need social services or rehabilitation care not generally available in acute care facilities.

Restorative care can be provided in a number of settings. More and more, acute care institutions are beginning to consider the establishment of a progressive care or self-care unit within their hospital, an extended care facility within the hospital, or a chronic disease and rehabilitation service within the hospital. In addition, nursing homes are now

establishing extended care services and home care service which are provided by health agencies such as the Visiting Nurses Association or by a home care unit of a community hospital.<sup>32</sup>

The general pressure on institutions to cut costs is pushing them into providing less labor intensive health services. Patients in restorative care units are usually ambulatory and generally require only limited nursing care. Some institutions in urban settings are establishing contractual relationships with rehabilitation hospitals in order to provide "coordinated multidisciplinary physician and restorative services."<sup>33</sup> In 1975, such units were reported in over 12% of non-federal, short-term hospitals.<sup>34</sup>

There is a growing sense that long-term institutionalization of patients suffering from mental disease should be avoided. Thus, more general hospitals are providing short-term in-patient care for psychiatric patients. Again, when these patients are ready for release they require restorative services which can be supplied in a number of ways, such as: day hospital programs for patients able to return home at night; evening or night hospital programs for patients who work during the day; out-patient psychiatric clinics attached to a hospital or a community mental health center; care in a private psychiatrist's office; and/or a halfway house, which provides a home and limited supervision for psychiatric patients who during the day hold down a job, go to school, or perhaps go to a day hospital program.

It is clear from all the above that hospitals, which originally focused on secondary and tertiary care, have increasingly expanded into primary care through their outpatient facilities and into restorative care through their progressive care, extended care, rehabilitation care, day hospital, and home care facilities. The nation's health care system is becoming dominated by hospitals, not only because they have the elaborate equipment the new medical technology requires but also because they have spread into other levels of care. The dominating role of hospitals has pushed the health care system into greater emphasis on high technology, but it may in time help integrate the increasingly differentiated levels of care.

This integration will tend to ameliorate the problems of access to health services. However, without a supporting communications network to link the various institutions together with their consumers in urban and rural areas, this development will be attenuated.

#### 6. Continuing Care

For patients for whom there is little expectation of improvement in their mental or physical condition, continuing care facilities have been established to meet the needs. There are three major types of continuing care institutions: nursing homes, personal care homes, and institutions for the mentally retarded or mentally ill.

Nursing homes provide both restorative care for convalescing patients and continuing care for the elderly. There are two major types of nursing homes: skilled nursing facilities which service almost two-thirds of the Medicare and Medicaid patients, and intermediate care facilities which provide a lesser level of medical attention to over 400,000 patients in over 8,000 institutions.<sup>35</sup>

As our elderly population has grown and the federal government has established the Medicare and Medicaid programs, our nursing homes have multiplied. The number of nursing home beds nearly tripled between 1961 and 1971.<sup>36</sup>

Personal care homes and domiciliary care homes provide a lower level of care to the elderly than nursing homes. Chronic care hospitals provide in-patient care for those who need skilled nursing services for chronic conditions such as mental retardation, emotional disorders, tuberculosis, cerebral palsy, and so forth. In most instances, these institutions are operated by some government unit.

It is the general feeling among critics of the industry that these facilities are not well run. For example, the Senate Special Committee on Aging in a survey of 14 states found that a majority of nursing homes are unsafe, inadequately staffed and neglectful of patients, and that nursing homes suffer from lack of physician coverage, have inadequate nursing staffs and, as a consequence, *"unlicensed aides and orderlies with little or no training provide 80% to 90% of the care in nursing homes."*<sup>37</sup>

Federal regulation of this sector of the industry will increase. The focus of the regulation will be on cost containment and the maintenance of minimal levels of quality. The effect of these regulations will be to force marginal institutions out of operation. Those which survive will aggregate their management capability, share scarce technological and personnel resources, and improve linkages to the more sophisticated health care institutions, such as the secondary or tertiary hospitals. Again, the provision of an adequate low-cost telecommunications system to appropriately link these institutions which are providing care at six different levels is essential.

Discharge from the institution to the home presents different kinds of problems. Institutionalized services are now so expensive that the patient would like to be released to his home as quickly as possible. The support mechanisms that have been developed to assist the patient in the home setting are several, such as the Visiting Nurses Association, homemaker services, etc. There are two disincentives to this practice. The majority of institutions providing patient care services (except for health maintenance organizations) do not have an economic incentive to release patients quickly. The second and perhaps more important concern is the medical appropriateness of placing the patient at some potential medical risk by early discharge without assurance of monitoring the patient's condition. This latter problem is an ideal opportunity for the use of telecommunications. It is now possible to monitor the vital signs of patients within an institutional setting, and one can envision a similar system being established for patients in their homes. For those patients at risk, the institution sponsoring such a program could develop a centralized monitoring system which could schedule review of all patients at risk, either automatically or through patient intervention.

#### D. Technology in Health Care: A Mixed Blessing

A spokesman for the Health Resources Administration observed:



*"We have been living through a technological revolution. In the home, the factory, the office, and in our health care system, new equipment and technology have appeared which have transformed virtually every aspect of life and living....Meanwhile, the revolution in technology, while creating 'medical miracles,' has also left in its wake ethical, social, political, and financial problems."*<sup>38</sup>

The total federal investment for health research from World War II through 1976 exceeded \$28 billion. Institutions of higher learning conducted over \$4 billion worth of scientific research in 1975. Only about one-third of these expenditures were financed by the colleges and universities themselves; nearly two-thirds were financed by the federal government.<sup>39</sup>

Total federal financing of basic and applied scientific research in and out of universities has risen over the last 20 years. However, the rate of increase slowed significantly after 1965 and in recent years has not been great enough to keep pace with inflation. The leveling off in the amount of money going into research probably will reduce the rate of technological change.

This massive infusion of federal monies into health research has spawned two kinds of technology which are transforming the U.S. health care system in a disturbing fashion. While clinical technology has vastly increased the cost of health care delivery, management technology thus far has effected only a modest cost savings.

Management information systems are slowly being implemented in the health system. In our pluralistic, fragmented health care system, the industry-wide changes which the logic of this technology mandates are in the embryonic stage. A standard format for medical records, which would be much appreciated by an increasingly transient patient population, is still years from acceptance. Even such a basic issue as improved hospital bill collection procedures has not been of great interest to the dominant force in the U.S. health care system, the physician. As hospitals have felt the impact of externally imposed cost controls, however, administrative efficiency has come to be appreciated. With the growing

influence of the professional hospital administrator has come increased use of electronic equipment to schedule hospital admissions, analyze, and report results of laboratory tests, maintain medical records, and assess the utilization and quality of physicians' services.

While management technology has been working its way slowly into the health field, clinical technology has been revolutionizing it. Physicians have eagerly sought to install sophisticated equipment which could keep them at the forefront of clinical practice. Examples include microscopic instruments which make it possible to perform surgery under a microscope, pacemakers in open heart surgery which have reduced mortality from heart disease, organ transplants and kidney dialysis, and computer-assisted diagnostic techniques such as computer-assisted axial tomography (CAT scanner). But this new medical technology is prodigiously expensive. In addition to the initial high purchase price, many past technical innovations were quickly outdated.

The critical weakness underlying the implementation of these new technologies has been the lack of adequate cost-benefit analysis during the investment planning. All too often when an improvement in medical technique has seemed likely, the cost to the patient of that improvement has been given scant consideration.

*"Griner compared adult patients suffering from pulmonary edema of nonsurgical causes who were admitted to the intensive care unit of a university hospital with those admitted to a general medical floor immediately before the opening of the special unit. In Griner's words, 'the most noticeable change in the overall experience of adult patients hospitalized with acute pulmonary edema...since the opening of an intensive care unit has been a marked increase in the cost of rendering care to these patients.'"*<sup>40</sup>

There have been other studies which indicate that coronary care units have had little positive effect on mortality rates from myocardial infarction, yet these expensive units are ubiquitous in U.S. hospitals.

Increased use of clinical technology in the health care system has several implications:

- .. By reducing the incidence of some communicable diseases and shortening recovery time for patients with other maladies, the probability of dealing with patients beset by chronic infirmities is increased.

*"The dramatic strides in medical care since World War II have, on the whole, increased, not diminished the need for health care."* <sup>41</sup>

- .. While the new clinical technology has raised the patient's expectations for performance, it has also raised questions about priorities and ethics. Emphasis on new techniques has helped to create a health care system that readily embraces new technology with inadequate concern for the increased cost of service.

#### 1. Regionalization of Health Services

Smaller, rural institutions cannot afford the expensive apparatus that modern medicine requires. These institutions are being compelled to share facilities or to merge in some fashion with other institutions or to focus on patients whose treatment does not require expensive hardware and specialized personnel. This trend toward consolidation of regional health care systems will require formalization of physician referral patterns and expansion on the part of the larger urban institutions into uncharted areas of medical marketing.

Contract management service is the latest development in the trend toward regionalization of hospital and health services. Several factors support this development:

- .. Public policy continues to stress system integration.
- .. Economic, social, and organizational factors make the multiple unit more attractive as a vehicle for delivering care in a cost-effective manner.
- .. Aggregated institutions are better able to raise investment capital.

National health leaders in the federal establishment believe that the recent planning legislation (Public Law 93-641) may reshape the nation's health system dramatically. The Act establishes the following ten priorities for national attention:

1. The provision of primary care services for medically underserved populations, especially those which are located in rural or economically depressed areas.
2. The development of multi-institutional systems for coordination or consolidation of institutional health services (including obstetric, pediatric, emergency medical, intensive and coronary care, and radiation therapy services).
3. The development of medical group practices (especially those whose services are appropriately coordinated or integrated with institutional health services), health maintenance organizations, and other organized systems for the provision of health care.
4. The training and increased utilization of physician extenders.
5. The development of multi-institutional arrangements for the sharing of support services necessary to all health services institutions.
6. The promotion of activities to achieve needed improvements in the quality of health services, including needs identified by the review activities of Professional Standards Review Organizations under Part B of Title XI of the Social Security Act.
7. The development by health service institutions of the capacity to provide various levels of care (including intensive care, acute general care, and extended care) on a geographically integrated basis.
8. The promotion of activities for the prevention of disease, including study of nutritional and environmental factors affecting health and provision of preventive health care services.
9. The adoption of uniform cost accounting, simplified-reimbursement, utilization reporting systems, and improved management procedures for health service institutions.
10. The development of effective methods of educating the general public concerning proper personal (including preventive) health care and methods for effective use of available health services.<sup>42</sup>

Interestingly, the new "solutions" focus on organizational control systems -- the professional manager's domain.

*"Of these national priorities, four deal primarily with the development of multiple unit health service systems and the other six deal with concerns for which multiple unit systems could, at least theoretically, do a better job. As the problems of financing the purchase of care are resolved, attention must inevitably focus upon the area where improvement in efficiency organization and control of delivery processes."<sup>43</sup>*

These observations cited by Dr. Montague Brown are echoed by a number of other leaders in the health establishment. There has been a spate of journal articles in recent months which point out the advantages of aggregation and the corporate management of health institutions.<sup>44,45,46,47</sup> The March 1, 1977, publication of Hospitals devotes the entire issue to multi-institutional arrangements.<sup>48</sup>

The availability of low-cost telecommunications should reinforce dramatically this trend toward aggregation of services. *"Institutions that start structuring themselves with other institutions now will be the ones to survive in the future,"* according to Jack McMehan, Executive Director, Philadelphia Health Management Corporation. *"Those who don't aggregate won't last."*<sup>49</sup> Telecommunications will enable institutions to share high-cost clinical and management technology. The new regionally based health service corporations most likely will implement satellite-based telecommunications support rapidly due to the fact that most of them serve institutional affiliates which are spread over a vast geographic region, some encompassing more than five states.

## 2. Health Information Systems for Hospitals

In an excellent article by Deland and Waxman, the characteristics of hospital information systems are critically reviewed:

*"It has been generally estimated that, in an average hospital, the cost of patient record-keeping and information handling is on the order of \$20.00 per patient day. The national magnitude of this cost, using the National Center for Health Statistics estimate of 500,000,000 hospital patient days annually, is \$10 billion. Even if we presume 100% error, the daily cost is \$10.00, and the national cost is still \$5 billion. This leads one to consider whether use of computer-based automation to support, supplement, or replace the all-manual methods would not (1) reduce the cost per patient day and, simultaneously, (2) improve patient management through more timely, complete, and accurate information."*<sup>50</sup>

The authors point out that the development of health information systems would be financially lucrative. Nonetheless, the rate of implementation of health information systems has been slow. Indeed, until recently little

R&D in the U.S. has been directed toward improving the productivity of the office, which is the heart of the problem.<sup>51</sup> Deland and Waxman conclude in their 1972 study that R&D is being carried out in six major categories of health information systems: (1) medical records, (2) business office transactions, (3) logistics, (4) diagnostic laboratory services, (5) physiological monitoring, and (6) total hospital information systems.

1. Subsumed under the category of medical records are three major activities: medical record-keeping; filing and retrieving orders, notes, and observations of the medical staff; and the rudimentary library function. The volume of information to be stored and retrieved is relatively modest by current standards (p. III-25), but difficult organizational adjustments are involved.
2. Included in the category of business office transactions are such activities as payroll, billing procedures, accounting and personnel operations. Hospitals usually automate these functions first. About three times as many hospitals report using their computer for business office transactions than for any other use.
3. Under the category of logistics, the major thrust has been in inventory control and distribution systems. Applications include software for pharmacy, dietary, central supply, and laundry services. High quality inventory control and distribution of supplies is widely available, and the health sector, although imposing special requirements, has been able to adapt computerized systems with relative ease.
4. The category of diagnostic laboratory services includes developments in the clinical laboratory, radiology, and multiphasic screening. The common point of origin of these services creates a data handling problem and a logistics problem. The most successful use of the computer in this area has been in the automation of the clinical chemistry laboratories which began with automatic analytic equipment.

5. In the Regional Medical Programs (RMPs) the physiological monitoring function pertains primarily to coronary care training programs. Computer communication networks are being used to monitor patients in intensive care units.
6. With regard to the development of a total Hospital Information System, Deland and Waxman observe that while several projects are underway in this category, no one has successfully developed a total hospital information system.

A leading software group in Ohio, Cincom Systems, Inc., has developed a consortium of health institutions which are working jointly to develop a total data base or management information system for the hospital field. Each member of the consortium focuses on one special aspect of the management information system problem, such as laboratories, outpatient departments, business office functions, etc. At the end of the project, each member institution is allowed to use the software products produced by the other institutions in the consortium. To date, the consortium is focusing on ten major software areas, and there are currently five institutional members. Cincom anticipates completing the project within the next two years, pending the capture of five additional consortium members. Cincom estimates that approximately \$4 million will be expended in the development of this management information system.

The linking of institutions and the sharing of computer systems is the next logical step in the development of health information systems. Currently, there are several groups of hospitals that operate under a single corporate structure-- specifically, Health Central, Inc., Minneapolis, Minnesota; Intermountain Health Care, Salt Lake City, Utah; the Lutheran Homes and Hospitals, Fargo, North Dakota; the Sisters of Mercy of the Union, Detroit Province, and several others. These organizations face a strategic decision: whether to use a central data base which can be accessed from remote points or to establish a dedicated computer facility for batch processing and to use decentralized mini-computers in the affiliated institutions.

A critical factor in this decision is the cost of telecommunications service. In the event that new applications of satellite communication networks can provide the broadband service required for rapid response at attractive prices, use of central data bases and large time-shared computer systems will begin to predominate. Mini-computers will continue to be used in this scenario to provide local data bases and to serve as the network interfaces. (Chapter VII)

### 3. Estimated Demand for Telecommunications Service

The two developing trends in the health sector which are most likely to involve extensive utilization of telecommunications are:

1. The aggregation and sharing of expensive clinical technology;  
and
2. The aggregation and sharing of scarce personnel resources,  
professional and managerial.

Although clinical technology has had major impact on patterns of health care delivery in the last 15 years, telecommunications utilization has been negligible. Each hospital has ordered its own equipment; there has been little sharing of resources. There are, however, opportunities to substitute communication for transportation in the areas of radiology, automated clinical laboratories, and multiphasic screening.

For example, two hospitals in Kansas City, Missouri, are now exploring with a major manufacturer the sharing of one CAT scanner. (It should be noted that development of this concept was vigorously resisted by the manufacturer.) There is insufficient data at this time, however, to estimate the volume of traffic associated with the sharing of clinical resources. Telemedicine falls into a similar category. There is insufficient data to estimate traffic volume.

A tentative estimate of the demand for administrative communications can be obtained by making a number of assumptions. First, the average cost of record keeping is assumed to be \$20 per patient per day. U.S. hospitals provided approximately 280,000,000 patient-days of service in



1976, generating record-keeping expenses of approximately \$5.6 billion, which is roughly 10% of the operating budget of U.S. hospitals.

At the Intermountain Health Care Corporation in Salt Lake City, Utah, a consortium of hospitals which is assumed to be representative of the hospital industry, the average administrative transaction consists of approximately 1000 characters or 8000 bits. It is assumed that hospitals having more than 100 beds provide an average of 70 transactions per patient-day and hospitals having less than 100 beds generate an average of 30 transactions per patient day. Noting that larger hospitals served about 80% of the patients, the average hospital generates approximately 62 transactions per patient-day. Thus, to provide record keeping to 7,000 U.S. hospitals from a central location, a total of  $1.39 \times 10^{14}$  bits of information would have to have been transmitted to the hospitals in 1976. For purposes of comparison, a single satellite transponder which operated continuously at 50 megabits could transmit  $1.58 \times 10^{15}$  bits per year. The entire hospital record-keeping function would utilize less than 9% of the capacity of such a transponder if the load were constant.

Hospitals which fully utilize computerized record keeping services spend an estimated 12% of their record keeping budget on automated services. Assuming that 15% of this "automation" budget could be captured by a national satellite carrier who placed terminals at each hospital, up to \$100 million of business could be available annually.

The conclusion to be drawn from this example is that a modest amount of transponder capacity could generate substantial revenue if the total system were responsive to existing requirements in the health sector. It should be noted that while the required total capacity appears to be modest, a wideband system probably will be required to provide acceptably low response times.

#### E. Cost and Quality of Health Care

##### 1. 1976 National Health Expenditure Highlights

- .. Total U.S. spending for health care reached \$132 billion, or a per capita expenditure of \$614.

- .. The 1976 total represented a 14% increase over the revised estimate of \$115.5 billion spent in fiscal 1975.
- .. In the two years since price controls on the health industry were lifted, estimated expenditures have risen \$31.0 billion or 31.0%, while the GNP as a whole has increased by only 18%.
- .. Public spending increased substantially -- up 15.6%. However, this was well below the 22.5% increase in 1975. Private spending rose by 12.8%, somewhat above the growth rate in the previous year.
- .. Hospital care expenditures of \$55.4 billion, at nearly 40% of total spending in health services, remained the largest expenditure category. This level was 15% above that estimated for 1975.
- .. Expenditures for physicians' services, estimated at \$26.4 billion, were nearly half as large as hospital expenditures. The figure for physicians' services represented an increase of 15% over 1975 expenditures.<sup>52</sup>

## 2. General Cost Trends

Health care is consuming an increasing proportion of the nation's gross national product and of consumers' incomes. During the last 15 years, total national expenditures for health services have risen more than six times, from \$20.9 billion to \$132 billion.

During this same period, there has been a dramatic shift in the role of the federal government in the financing of these health services; the federal contribution has increased from 25% to 40% of total expenditures. This shift from private to public funds is due primarily to the introduction of Medicare and Medicaid in 1966. In contrast, public financing of medical facility construction declined from 52% of the total in 1960 to 17% in 1976 as health facilities were able to finance a growing portion of their construction costs with commercial loans.<sup>53</sup> But use of private money markets and the cost of debt service has increased the fixed costs of institutional services.

The institutionalization of primary health services and the growing use of secondary and tertiary care has caused a shift in expenditures for health services. A growing portion of the health dollar is paid to hospitals and nursing homes. Whereas hospitals consumed 31% of national health expenditures in 1950, they absorbed 40% in 1976. Nursing homes

received only 1.5% of the U.S. health dollar in 1950, but 8.9% in 1976. The percentage of the health dollar paid to physicians and dentists has declined somewhat, and the percentage paid for drugs and sundries dropped from 13.6% in 1950 to 8.8% in 1976. The changing distribution of the health dollar is the result of different growth rates and per capita expenditures for different health services. Total per capita expenditures for hospital care grew from \$24.09 in 1950 to \$254.00 in 1976, while total per capita expenditures for nursing home care climbed from \$1.16 in 1950 to \$48.64 in 1976. These increases are far greater than the increases in per capita expenditures for doctors and dentists, as can be seen in Appendix III.B.

This shift in expenditures reflects the growing role of institutions, especially the hospital, in the health system. Increasingly sophisticated medical technology requires that more and more care be provided where elaborate equipment is available. The fact that the population is growing older has increased the demand for both hospital beds and nursing homes. The hospital and nursing home are becoming the key elements of our health care system, and the government is becoming their chief financier.

The increased federal involvement in the financing of our health care system has not kept the consumer from feeling the pinch of skyrocketing costs. Private expenditures for health and medical care totaled \$80.4 billion in 1976, more than four times the \$19.5 billion spent in 1960.<sup>54</sup> On a per capita basis, private expenditures for health services and supplies climbed steadily from \$78.35 in 1950 to \$141.63 in 1960, to \$614.23 in 1976.<sup>55</sup>

As in other areas of public service, medical care prices have risen faster than the overall consumer price index. This is due primarily to the labor-intensive nature of public service industries: salaries have been rising faster than the overall productivity of the service sector. But hospital costs have accelerated even more rapidly than salaries. The cost of a semi-private room in a hospital increased 229% between 1967 and April 1975.<sup>56</sup>

### 3. Crisis in Hospital Costs

The steepest cost inflation in the health care sector has occurred in hospitals. There are a number of reasons for the escalation in hospital expenses, but the principal ones are as follows:

- a. The ease with which hospitals can pass on their costs;
- b. The growing capital intensiveness of hospital care;
- c. The changing method of financing hospital capital expenses.

During the last 15 years the total expenses for nonfederal, short-term hospitals have multiplied six times, rising from \$5.6 billion to \$55.4 billion.<sup>57</sup> Appendix III.B indicates that the rate of increase was considerably slower in the pre-Medicare period than it was later.

There are several reasons for these dramatic increases, which are summarized in Appendix III.C.

- a. General inflation: Hospitals have faced rising prices for food, fuel, construction, and personnel. For example, between January 1973 and July 1974, hospitals had to pay 15% more for the food served patients and 17% more for fuel to heat their facilities.<sup>58</sup>
- b. Increased utilization of short-term hospitals: In nonfederal, short-term hospitals, patient days per 1,000 civilian population increased from 1,072 in 1965 to 1,194 in 1973.<sup>59</sup> This increase in the intensity of use of hospital service has many causes, among them the following:
  - . As the population has grown older, the demand for health services has increased.
  - . More people can afford to use hospitals and other health services, in part because of the increasing affluence of the population, but mostly because a growing number of people have their health expenses covered in part by Medicare, Medicaid, and other health insurance programs.

The present surplus of hospital beds may in itself be stimulating the demand for hospital care. *"The observation that the number of hospital beds per 1,000 population differs substantially among areas without any sizable effect on the*

*occupancy rate has led to the proposition that the supply of beds 'creates' its own demand."*<sup>60</sup>

Decreased utilization of long-term hospitals (tuberculosis sanatoriums, mental hospitals, and other state-operated facilities) has increased the demand for short-term hospital beds. While short-term hospital patient days per 1000 civilian population increased 21% between 1965 and 1973, long-term hospital patient days per 1000 civilian population were cut in half during that period, dropping from 131 in 1965 to 69 in 1973.<sup>61</sup>

Medical technology has increased demand for hospital care. New treatment modalities have been developed for diseases which, in an earlier time, were considered untreatable. These new therapies often require elaborate equipment available only in the hospital setting.

The growing specialization of physicians brought about by the knowledge explosion, and new technology, appears to be increasing demand for hospital care.

*"A greater availability of a general practitioner appears to reduce the demand for both admissions and for longer stays while a greater availability of other doctors has the opposite effect... Estimates suggest that an increase in the number of general practitioners would induce a very large savings in hospital resources, on the order of \$39,000 a year per general practitioner."*<sup>62</sup>

Hospital emergency rooms are being used for primary care which was formerly provided by private physicians. The trend has been precipitated by a growing dependence on the part of the physician on the institutional support provided by the hospital and its advanced technology.

- c. Increased capital and equipment costs of hospitals; questionable productivity gains: Nonpayroll costs of a hospital have risen faster than payroll costs. In 1960, nonpayroll expenses were 37% of the total expenses of hospital operations, but by 1973 they had grown to 44% of the total. Assets per bed for these institutions rose from \$17,000 per bed in 1960 to \$42,000 per bed in 1973, with the biggest jump in assets occurring in the post-Medicare years. From the period 1960 to 1965, assets per bed rose 18%, but increased 54% during the five-year period between 1968 and 1973.<sup>63</sup>
- d. Higher personnel costs: During this same period from 1960 to 1973 when investment in capital equipment had been skyrocketing, the number of hospital personnel per patient had risen from 2.26 to 3.13 (Appendix III.D). More highly specialized personnel and more personnel per hospital bed are required to operate the increasingly sophisticated facilities required by the new medical technology. Hospitals have been compelled to increase their wages in order to attract an adequate number of employees. In addition, the hospitals have had to "catch up" to other industries in order to maintain parity and recruit individuals to the health field. In the early '60s the average earnings of those people employed in medical and other health services were only 66% of the average earnings in all industries. After Medicare was introduced, wages in the health system began to rise more rapidly than wages elsewhere until, by 1973, average earnings in the health services were approximating 80% of those in industry as a whole. In large urban centers such as New York City, hospital employees now operate at 105% of parity.

*"In particular, the wage rates of clerical, housekeeping, and maintenance workers in hospitals have risen much more rapidly than the rates in such occupations in other industries...moreover, the rates of wage increases have been as high for professional nursing and technical staff as well as the less skilled employee."*<sup>64</sup>

- e. Weakening of incentives to keep costs down: The initial reimbursement formula established by HEW for Medicare patients was cost plus 2%. This, coupled with physician demands for new services and the hospital's willingness to pass on the cost to the consumer, has produced disincentive for cost constraint.

*"Doctors have been eager to add elaborate equipment to the hospitals in which they practice for practicing in a well equipped hospital added to their prestige in our technology-conscious health care system, while the high cost of that equipment was of little concern to the doctors who were able to use it at no expense to themselves. In short, physicians in general have had no financial incentive to keep hospital costs down and it is they who largely determine both the administration and the costs of hospitals."*<sup>65</sup>

It should be pointed out that the consumer is equally to blame. Consumers protest loudly about rising health insurance premiums, but when they enter a hospital they want the best possible care, because so much of the cost is covered by health insurance. To wit, patients in 1950 paid about one-third of their hospital bills directly; in 1974 they were paying approximately 10%. The remaining 90% was covered by the government (54%) and private health insurance (35%), with philanthropy (1%) paying the remainder.<sup>66</sup>

The combination of pressure to purchase high technology, combined with weak incentives to keep costs down, has tended to encourage hospitals to add facilities and services for which there was inadequate demand. For example, of the nearly 800 hospitals which were equipped to perform open heart surgery in 1972, one-third did not perform a single operation and another one-third performed less than 12 operations.<sup>67</sup>

- f. Increased cost per patient day triggered by efforts to reduce utilization: Hospital utilization review procedures and other efforts to eliminate unnecessary use of expensive hospital services can have the perverse effect of increasing cost per patient day.

*"The elimination of unnecessary hospitalization may lower hospital occupancy rates. An unoccupied bed can cost the hospital as much as \$36,000 a year in fixed costs and these costs have to be added to the cost of caring for those patients who do occupy hospital beds."*<sup>68</sup>

By reducing the average patient stay, the total cost of service may be reduced, but occupancy rates may decline and hospitals may lose revenues. Negotiations between third-party payers (such as Blue Cross-Blue Shield, private insurers, and the federal government) to require that patients be treated as much as possible on an out-patient basis have been delicate. An immediate implication is that those patients who are actually admitted to the hospital are more likely to have complex maladies which require expensive treatment. Thus, as the average patient stay has declined, the average cost per patient day has risen because there are fewer patients with simple problems to treat. Also, the most expensive part of the hospital stay is the first few days when the patient is given more treatment than is generally the case toward the end of the hospital stay.

### 3. Response of the Carter Administration

The recent reorganization of the Department of Health, Education and Welfare reflects the Carter Administration's increasing concern with costs and management. The reorganization plan:

- a. Establishes a new organization, the Health Care Financing Administration, to oversee Medicare, Medicaid and other health programs;
- b. Consolidates all case assistance programs from retirement benefits to welfare payments, under the Social Security Administration, which will also continue handling Medicare's computer services;
- c. Consolidates all social service programs, from day care through senior citizens' services, under the Assistant Secretary for Human Development;
- d. Lumps together management of all student financial aid programs in a new Bureau of Student Financial Assistance; and
- e. Creates a new structure for managing HEW's budget and personnel.<sup>69</sup>



With this restructuring will come increasing pressure to reduce costs in the health sector. Aggregation, sharing and regionalizing systems of delivery will be pushed as one more solution to the ever-increasing problem of rapidly escalating costs. The application of new telecommunications technology is being viewed very positively by the leaders of this cost-reduction effort.

#### 5. Quality of Health Care

Review of the care provided in hospitals began long before the government became concerned about health care costs. The American College of Surgeons in 1949 established the concept of tissue committees, which examine human tissue removed during surgery to see whether the operation was justified. The Joint Commission on Accreditation of Hospitals in 1953 enunciated the concept of medical audits to measure the quality of care provided in hospitals, and in 1974 this Commission decreed that hospitals must have an acceptable medical-audit procedure in order to be accredited. Both the medical audits and the tissue committees were designed to maintain the quality of care, not to control the cost of that care.<sup>70</sup>

The Medicare law mandated that hospitals have a utilization review plan in order to be eligible to participate in the Medicare program. Hospitals set up utilization review committees, staffed by physicians, to determine whether patients actually required hospitalization and whether patients were being kept in the hospital longer than was medically necessary. The principal focus of these committees was in the area of costs and not quality control.

The Social Security amendments of 1972 created a stronger tool for the control of both costs and quality of care: Professional Standards Review Organizations (PSROs). The PSRO is to review the care provided Medicare/Medicaid patients to insure that "the services for which payment may be made under the Social Security Act will conform to appropriate professional standards and that payment for such services will be made: (1) only when, and to the extent, medically necessary, and (2) in the case of services provided...on an inpatient basis, only when and for such period as such services cannot...effectively be provided on an outpatient basis or more economically in a health care facility of a different type..."<sup>71</sup>

PSROs are designed to eliminate not only unnecessary care but also poor care. However, the general suspicion of most physicians, hospital administrators, and other health executives is that by emphasizing cost control, PSROs have stifled innovation.

Perhaps the most important influence on the quality of medical care is the growing trend on the part of state licensing agencies to require periodic continuing education for health professionals within their states in order to obtain relicensure and the actions taken by the professional associations which control the certification of health professionals to require continuing education for their continued recertification. The application of telecommunications technology to continuing education for health professionals is discussed in Chapter VI.

#### F. Validation Process

The case study validation procedures included extensive review of the literature and interviews conducted with members of an expert panel (Appendix III.E). The panel was asked to confirm or refute the intuitive assessments which served as the basis for the review of the health industry.

Composite responses from the panel of experts were analyzed, and the recommendations were included in each of the sections discussed in the case study. In those instances where there was disagreement with PSSC, the commentary was either modified or specific disagreements cited. The conclusions drawn from the case study analysis reflect the opinions of the panel of experts, trends derived from review of the literature, and the opinions of the author. In general, the conclusions drawn reflect the majority of the opinions of the panel of experts interviewed by the author.

## G. Summary and Conclusion

The principal problems facing the health service industry are access to patient care, skyrocketing costs, and quality. The application of new telecommunications systems in the health industry can help resolve each of these major problem areas.

Telecommunications could improve health services by:

1. Increasing consumer awareness of health hazards via mass radio and television. Satellite distribution could be especially useful in rural regions of the nation which presently do not have access to public television.
2. Improving access to primary, secondary, tertiary, and restorative services by enabling the provider to maintain his linkage to institutional sources of support, regardless of geographic location, i.e. by substituting communication for transportation.
3. Helping emergency medical services maintain voice contact with distant institutional support systems regardless of local terrain.
4. Reducing the clinical risk of referring patients to their homes by providing physiological monitoring.

Cost containment or expenditure reduction will be the federal government's major concern in the health sector in coming months and years. The implementation of national health insurance probably will not occur until the current delivery system can be reorganized and controlled economically. The development of regionally-based systems of care will be one of the highest priority areas in which the federal government will focus its activities. In rural regions of the nation, low-cost telecommunications services which could link the various institutional providers to one another and to a regionally-based tertiary care center are a prerequisite to the development of these regional networks.

The maintenance of minimal levels of quality is also a major concern of the federal establishment and the consumer. It will be impossible to maintain quality in rural regions of the nation without a communications system to support the individual provider.

The two developing trends which are most likely to involve extensive utilization of telecommunications technology are:

1. The aggregation and sharing of expensive clinical technology (clinical laboratory networks, clinical radiology consultation, and multiphasic testing); and
2. The aggregation and sharing of scarce personnel resources, professional and managerial (management information systems for accounting, billing, inventory control, and medical records; emergency medical services; and institutional and professional support to remote rural providers, institutional and professional).

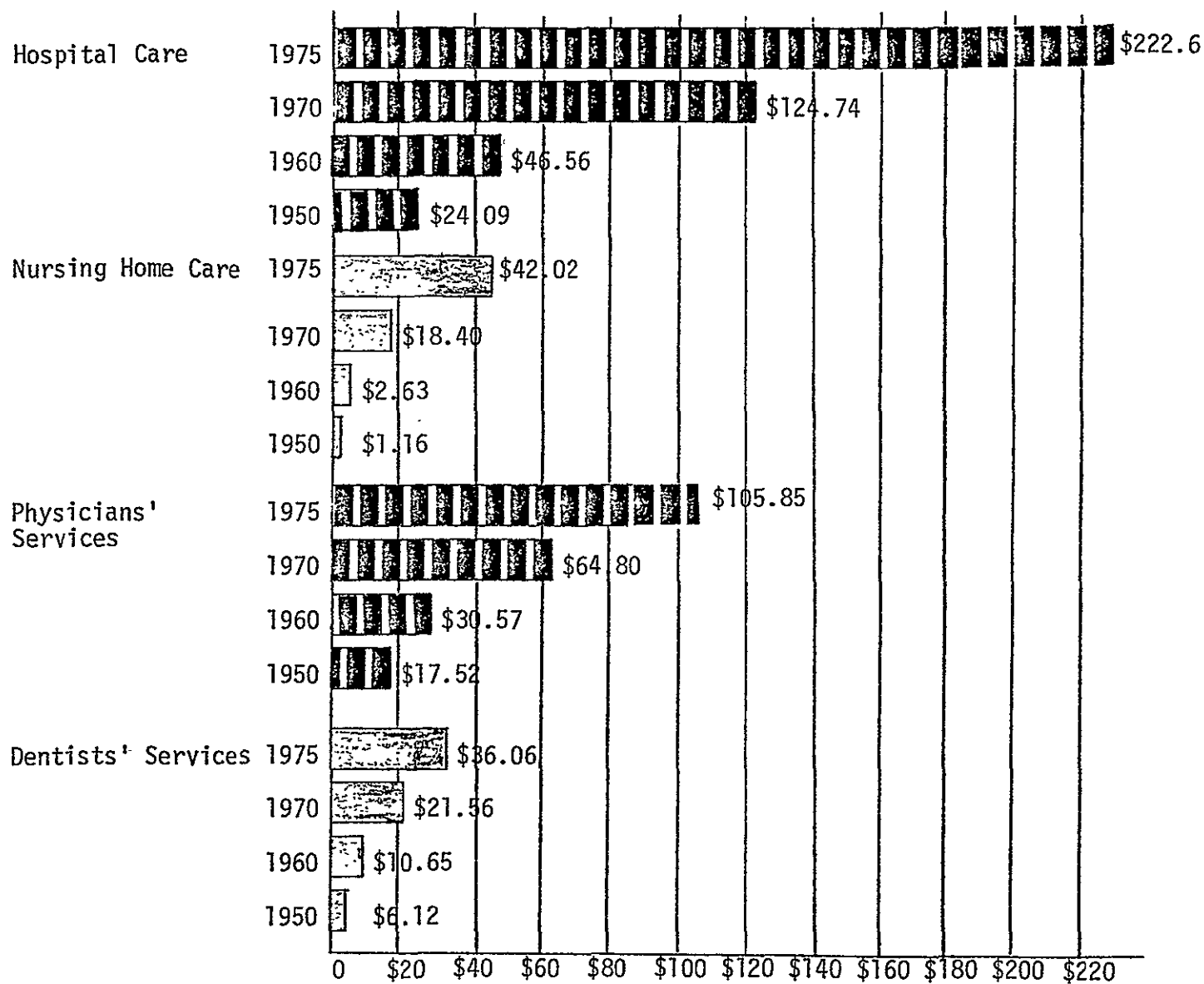
Cost benefit studies, as well as further research and development, will be required before any systemwide applications can be made. The continued growth and improvement in our nation's health system will only come about through the reorganization of the disparate, autonomous institutional providers. This restructuring can be accelerated through the provision of a low-cost telecommunications system.

# APPENDIX III.A.

## HEALTH CARE SYSTEM

Level of Care	Description	Provider Groups/Institutions	Integration Models
I. PREVENTIVE CARE	Education Prevention	Family Planning Clinics Poison Information and Control Centers Well-Baby Clinics School Health Education Neighborhood Health Centers Doctors Office-Based Practice	<ul style="list-style-type: none"> <li>• Health Maintenance Organizations</li> <li>• Shared Services</li> <li>• Regionalization of Care</li> <li>• Transfer Agreements</li> </ul>
II. PRIMARY CARE	Early Detection Routine Care	Hospital Outpatient Departments Community Mental Health Centers Industrial Health Units School and College Health Units Neighborhood Health Centers Migrant Health Centers Doctors Office-Based Practice	
III. SECONDARY CARE	Emergency Treatment Acute-Critical Care	Hospital Emergency Departments Hospital Ambulatory Services Hospital Inpatient Services Community Hospitals Teaching Hospitals	
IV. TERTIARY CARE	Highly Specialized Care	Specialty Hospitals General Hospitals with Highly Specialized Facilities Teaching Hospitals	
V. RESTORATIVE CARE	Intermediate and Follow Up Care Rehabilitation Home Care	Homes for Unwed Mothers Home Health Agencies Extended and Home Care Units in Hospitals Halfway Houses Nursing Homes Inpatient Health Facilities Hospital Outpatient Facilities Community Mental Health Clinics Psychiatric Clinics	
VI. CONTINUING CARE	Long-Term Care Chronic Care Personal Care	Personal Care/Domiciliary Homes Inpatient Health Facilities Geriatric Day Care Centers Nursing Homes Institutions for the Mentally Ill or Mentally Retarded <i>III-37</i>	

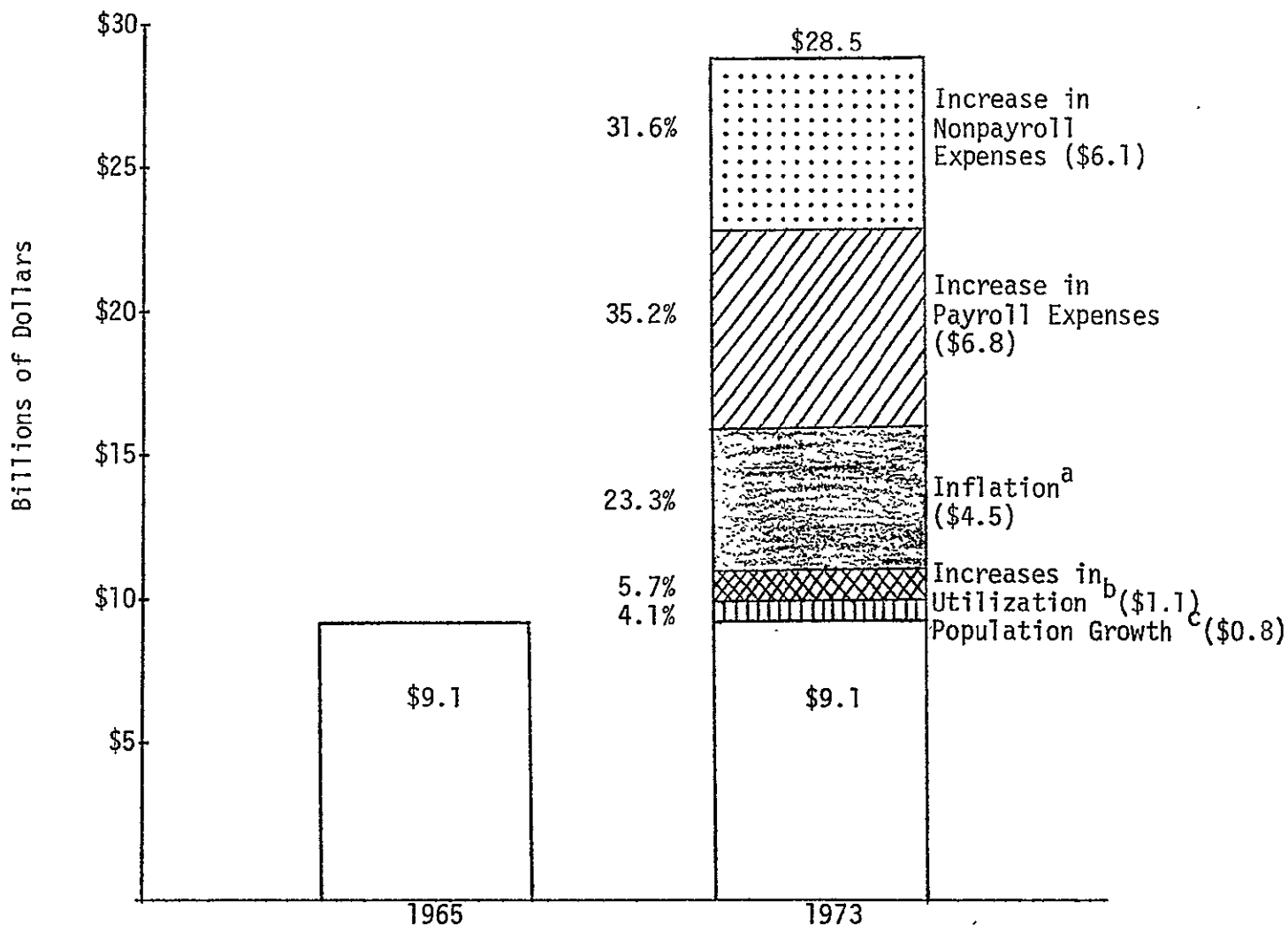
APPENDIX III.B.  
PER CAPITA EXPENDITURES FOR SELECTED HEALTH  
SERVICES: SELECTED YEARS 1950-1975



Source: Nancy Worthington, "National Health Expenditures, 1929-74," Social Security Bulletin, February 1975, p. 13.

# APPENDIX III.C.

## FACTORS CONTRIBUTING TO THE INCREASE IN NONFEDERAL SHORT-TERM HOSPITAL EXPENDITURES: 1965 and 1973



Source: American Hospital Association, Hospital Statistics, 1974 Edition (Chicago, Illinois: 1974), p. 20.

Note: All amounts, except those due to inflation, have been adjusted for the decreasing purchasing power of the dollar.

<sup>a</sup>The Consumer Price Index rose 40.8% between 1965 and 1973.

<sup>b</sup>Nonfederal short-term hospital patient days per 1,000 civilian population increased from 1,072 in 1965 to 1,194 in 1973.

<sup>c</sup>The U.S. civilian population increased 8.6% between 1965 and 1973.

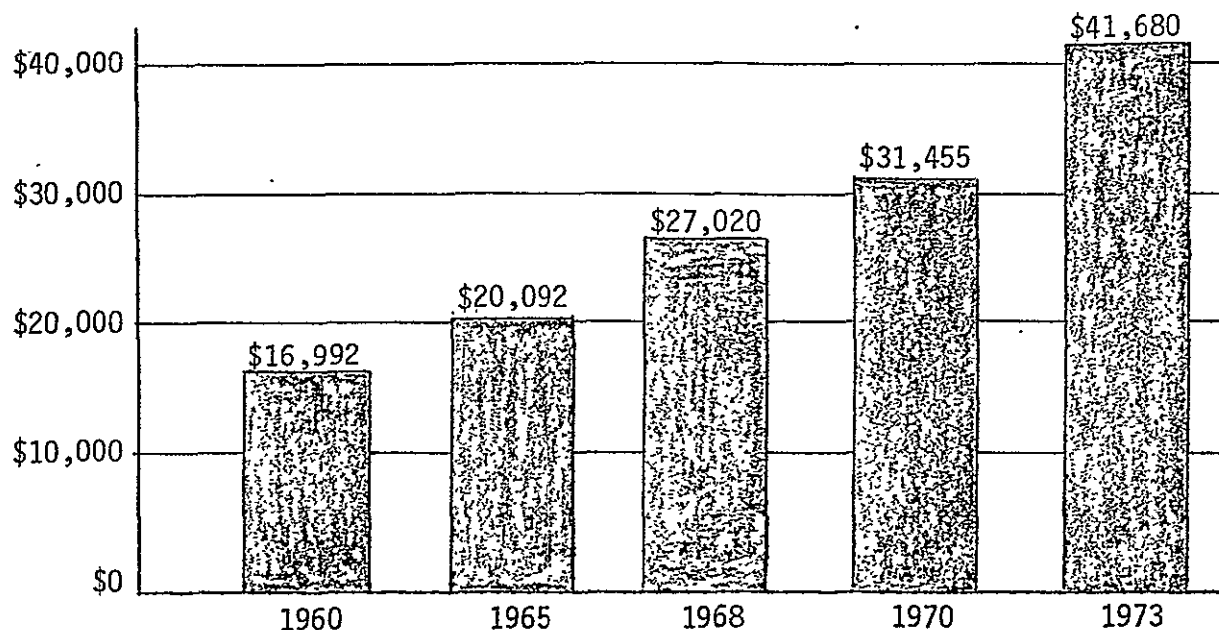
APPENDIX III.D.

ASSETS PER BED AND PERSONNEL PER PATIENT:

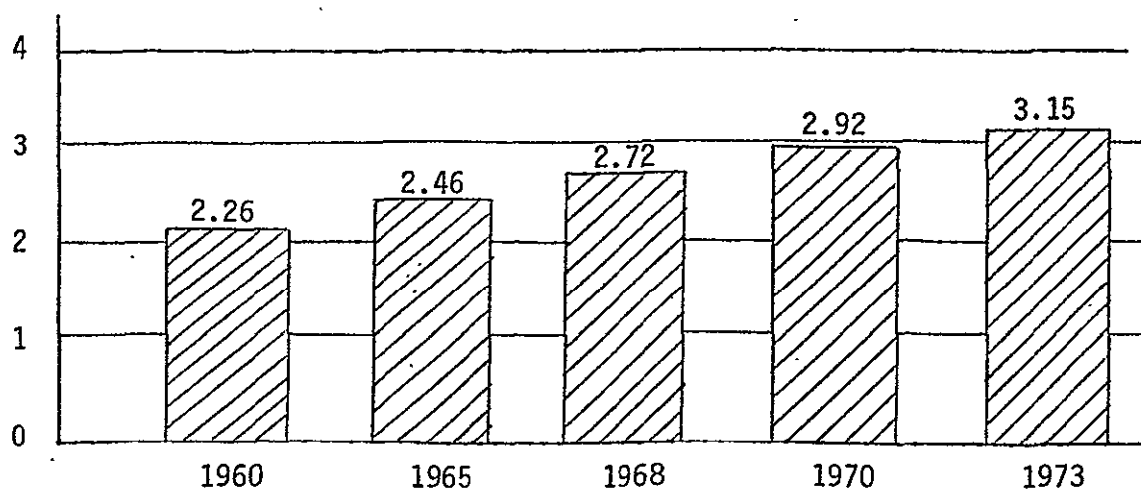
SELECTED YEARS 1960-1973

(Non-federal, short-term hospitals)

Assets Per Bed:



Personnel Per Patient:<sup>a</sup>



Source: American Hospital Association, Hospital Statistics: 1974 Edition

<sup>a</sup>Personnel per patient in the average daily census.



## APPENDIX III.E.

### PANEL OF EXPERTS

1. Bruce Brennan  
Director of Media Communications  
American Hospital Association  
Chicago, Illinois
2. Carlton Evans, M.D.  
Director of Health Services Research  
and Development  
Veterans Administration  
Washington, D.C.
3. Gary Filerman, Ph.D.  
Executive Director  
Association of University Programs in Health  
Administration  
Washington, D.C.
4. Samuel Levy, Ph.D.  
Professor and Head  
Department of Health Administration  
Bernard Baruch School of Business  
City University of New York  
New York, New York
5. Robert McGowan  
Principle  
Cincom Systems, Inc.  
Cincinnati, Ohio
6. Harold Mendelsohn, Ph.D.  
Professor of Communications  
Denver University  
Denver, Colorado
7. Carol Mickey, Ph.D.  
American College of Hospital Administrators  
Chicago, Illinois
8. Scott Parker  
President  
Intermountain Health Care, Inc.  
Salt Lake City, Utah
9. David Pomerinse, M.D.  
President  
Mount Sinai Medical Center  
New York, New York
10. David Rust  
Staff Assistant  
Senate Committee on Aging  
Washington, D.C.
11. Blair Sadler  
Assistant Vice President  
Robert Wood Johnson Foundation  
Princeton, New Jersey
12. Heidi Wagner  
Assistant Professor  
Allied Health Sciences  
Boston University  
Boston, Massachusetts

Appendix III.E. (cont.)

- |                      |  |
|----------------------|--|
| 13. Gail Warden      | Executive Vice President<br>American Hospital Association<br>Chicago, Illinois |
| 14. Donald Wegniller | Executive Vice President<br>Health Central, Inc.<br>Minneapolis, Minnesota     |

## CHAPTER III

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## CHAPTER IV

### PROSPECTS FOR ADVANCED TELECOMMUNICATIONS IN EDUCATION

#### A. Introduction

The dawn of the Age of Information is creating exciting prospects for the educational community. Prior to examining the possible role of telecommunications, a review of the field is appropriate to clarify the all-encompassing phenomenon known as education. Education, in its broadest sense, includes preschool to higher education, continuing education to rehabilitation, parent education to vocational education. Education is a vital element of the public service community, accounting for 8% of the GNP, employing 2.1 million professional persons, and having a projected annual budget for 1978 in excess of \$119 billion.<sup>1</sup> It includes principals, librarians, teachers, specialists, school lunch personnel, and bus drivers, all of whom require some form of continuing education to combat career obsolescence.

Education has a vast scope, and there is no one accepted definition. The diversity between and within disciplines defies a generic description. There are problems common to all facets of education -- problems that perhaps could be alleviated through appropriate use of telecommunication technology. There are some basic issues, however, that will impact on any comprehensive system innovation which must be considered.

In the United States most major public services, including education, health care, library services, and even public safety are fundamentally local. This high level of local autonomy is clearly reflected in the fragmentation of educational services and programs. Subtle changes are occurring in public education, however, which are creating better opportunities for systemwide innovation.

Societal change leads to institutional change. Education legislation reflects the demand for "accountability," but the desired reforms are implemented slowly. In future years, education will be asked to reflect changes in our understanding of the societal, political, and physical environment. The system will be asked to provide more services at lower per-unit costs in the face of diminishing demand for traditional forms of instruction. Aggregation and better use of

information networks provide an alternative, but fundamental organizational changes will be necessary to gain acceptance and to achieve productivity gains.

#### B. Trends

American education in recent years has witnessed many quick and simple answers to some very complex questions as evidenced by a number of emerging trends:

- More and better qualified teachers competing for fewer positions.

By 1980 there may be as many as 240,000 new teachers competing for 90,000 openings.<sup>2</sup>

- Integration of schools and school programs.

As of 1974, four out of every ten black students and three out of every ten Hispanic students were still attending schools with at least 90% minority enrollment.<sup>3</sup>

- Greater appreciation for cultural differences.

The minority population in public elementary schools will exceed 18% by 1980.<sup>4</sup>

- Decreases in enrollment.

Public school enrollment peaked at 46 million in 1970-71 and has been declining steadily. Presently it is down 1.7 million and by 1983 will be down almost 6 million.<sup>5</sup>

- Attitude change toward education.

The Gallup Poll conducted in April, 1976, found that 55% of people surveyed want school outlays reduced and cuts in the number of teachers to match declines in enrollment.<sup>6</sup>

- Changing role of school facilities in the community.

Many school facilities are no longer locked at 3 p.m. but are becoming community centers which serve a variety of interests.

- Changing role of the traditional educator.

Most state educational agencies now mandate the upgrading of skills and competencies of professional staff.<sup>7</sup>

- Alternative educational models more prevalent.

The creation, recognition, and certification of open schools -- schools without walls, alternative schools, nontraditional education, etc. -- are evident in most cities.



- The presence of more specialists in the schools.

The self-contained classroom is now reinforced with reading and metric math specialists, music and speech therapists, resource teachers, etc.

- New approaches to funding schools which allow for flexible budgeting.

The growth of non-categorical funding. The recent White House proposal to consolidate 23 elementary, secondary, handicapped, vocational and adult education programs into one block grant serves as an illustration.<sup>8</sup>

Yet the traditional education system prevails, and the issues remain the same. Facilitating innovation in education remains a complex task. Problems of certification, licensing, funding, labor intensity, accountability, civil rights, and collective bargaining must be resolved before telecommunications are utilized extensively in the public schools. Telecommunications usage in education presents additional issues in need of reconciliation, such as the need for agreement on subject matter to be distributed regionally, the autonomy of the school system which demands local control and defies outside intervention, and the fact that no national educational organization determines policy. The National Education Association (NEA), as with other educational organizations and associations representing specific disciplines, at best provides guidance and counsel to their particular constituents. They cannot mandate that their membership, which represents only a small percentage of professionals in the field, upgrade their training and competencies.

What will be required to effectively implement telecommunication technology in the schools and community? First of all, educational institutions must adapt their planning, budgeting, and operating practices to meet the requirements of a regional delivery system. Regional leadership with strong local support will be necessary. If schools are to contribute to the development of the system, extensive lead time will be required. Often capital funding decisions cannot be made without passage of new bond issues. The labor intensity of schools, particularly small schools, will create barriers to acceptance. The school community will have to be educated to understand the benefits and shortcomings of the new system.

In the future schools will be required to break their traditional mold. Classes may be conducted at local learning centers, rather than in traditional

schools. School administrators will have to make difficult and unpopular decisions, committing dollars to support labor-saving technology rather than hiring another teacher. States will have to revise their certification and licensing requirements to accept television instruction. They will have to share resources and facilities with other community agencies if they are to honor their commitments. They will have to sacrifice a measure of local autonomy in exchange for better service.

Teacher education, particularly continuing education, could benefit from the use of mediated instruction. (Chapter VI) By using a "university without walls" arrangement, the granting of reciprocal credit could be negotiated among regional institutions of higher education, providing an incentive for students and educators to participate in the program.

School reform and improvement is inevitable in all areas of education. This study, however, is intended to identify a limited number of areas which could effectively utilize telecommunications.

### C. Criteria for Selection

The selection of educational areas for inclusion in this study was based on a judgment of how amenable the particular field was to the use of telecommunications. Selection criteria included the following:

- National Need
- Mandate by Law
- Limited Resources
- Specialized Services not Presently Available
- High Probability of Success

#### 1. National Need

The nation's most valuable resource is its people. Changes in today's society necessitate a reallocation of educational resources. For example, 53% of the U.S. mothers are now in the labor force,<sup>9</sup> and over 20% of the adult population is estimated to enroll each year in some kind of continuing education.<sup>10</sup> The educational system must now provide entry points for people of all ages.

The educational system is being asked to ameliorate problems which were outside its purview only a decade ago. State and federal regulations and

public demands for increased accountability preclude exclusive attention to the "three Rs," the wishes of many parents notwithstanding. School systems are now required to address the special needs of handicapped children, minority children, and migrant children, and to provide relief to complex social issues such as child abuse, drug and alcohol abuse, mental health, and vocational education in the changing economy.

It will be increasingly necessary for autonomous educational units to share resources. For example, there are over 16,000 superintendents in the U.S. More than 4,000 school districts have an enrollment of 300 or less, and over 8,000 have an enrollment of 1,000 or less. Maryland, which has 25 school districts, now has a mechanism which interconnects the superintendents. But Montana, which has 770 school districts, does not have such a mechanism.

In evaluating the possible utility of a telecommunications system, one must ask if there is a national or regional need. Is the required response similar in many different localities? Is it likely that the present service or a functional equivalent could be delivered at a higher level of quality and/or a lower cost through appropriate use of telecommunications? Do the required organizational, financial and technical adjustments appear to be tractable?

## 2. Mandate by Law

The Constitution of the United States guarantees certain rights and privileges to its citizens. The right to education is guaranteed under the equal protection clause of the 14th Amendment and the due process clauses of the 5th and 14th Amendments. Historically, however, educational opportunities have not been equitable.

Title VI of the Civil Rights Act of 1964, in an effort to clarify the intent of the law, requires that there be no discrimination on the basis of sex, race, color, or national origin in the operation of any federally-assisted program. The integration of schools throughout the country followed. But de facto discrimination continues, particularly in regard to ethnic minorities and the handicapped.

In 1974, the U.S. Supreme Court ruled that San Francisco's failure to provide instruction to non-English speaking children violated the Civil Rights Act.<sup>11</sup> This Lau vs. Nichols decision is now having a far-reaching impact on

non-English speaking students throughout the nation. The remedy which is commonly used to ensure compliance with the law is bilingual instruction, but the majority of schools across the country are having great difficulty complying with the law. Quality programs generally are not available and there is a lack of trained teachers.

In 1975, the U.S. Congress passed the Education for All Handicapped Children Act, which now guarantees education to all handicapped children. At the present time, it is estimated that only about 40% of handicapped children and youth are receiving an adequate education.<sup>12</sup> Compliance with the law will necessitate that school districts expand appropriate services for the handicapped. An alternative approach will be required.

### 3. Limited Resources

Total expenditures for education have increased faster than the gross national product (p. I-4). Educational expenditures were 5.1% of the GNP in 1960 and 7.9% of the GNP in 1976.<sup>13</sup>

Teachers' salaries have increased dramatically. Collective bargaining, in its efforts to promote teacher rights, has created an additional economic burden on the schools. Many school districts for the first time are now finding bond issues defeated because of the negative community reaction to increased taxes which support schools.<sup>14</sup>

### 4. Specialized Services Not Presently Available

Special populations -- the handicapped, preschool, the migrant, the linguistically and culturally different child -- are not adequately served in the schools. Projections for appropriate services and programs are not encouraging, and the high cost of traditional delivery is prohibitive, particularly in rural areas.

### 5. High Probability of Success

Numerous fields of education could benefit from advanced telecommunication technology. PSSC believes intuitively that the following disciplines are most amenable to the use of telecommunications:

- Administrative and Management Services
- Rural Education
- Education for the Handicapped
- Migrant Education
- Vocational Education
- Multicultural/Bilingual Education

Discussion of each of these areas follows. PSSC's findings were validated by a panel of experts. The opinions of these experts are summarized in Section IV.E.

#### D. Major Problems and Opportunities in Six Selected Areas of Elementary and Secondary Education

##### 1. Administrative and Management Services

In the last decade, education has undergone profound internal alterations. The impact on school administrators has been significant. With all the changes in society today, many of which intimately involve public education, school administrators are being confronted with a multitude of problems.

The most troublesome issues include reduced enrollment, a surplus of teachers, increasing specialization, civil rights, collective bargaining, accountability, discipline problems, desegregation, energy conservation, and new funding patterns. Perhaps the issue that is most familiar to the traditional administrator is parental concern for quality education. The "back to basics" movement is all too familiar to most administrators, but is inconsistent with the social environment of the schools: the responsibilities of schools today include more than the traditional concern for the "three Rs."

A school administrator, particularly in a rural school, needs improved access to information. An occasional workshop for administrators is inadequate; the answer lies in an interactive system, which provides relevant, up-to-date, and economical information.

Information networks could accommodate many information needs of school districts and of state and federal educational agencies. Some applications of a regional information network which was designed for educational administrators would include:

##### a. Computer-managed instruction.

Information networks could be used to monitor student progress and give options for further study. A central computer could be used to analyze each student's progress and compare daily

progress data with previously-entered personal data, classroom profiles, and past and future course objectives.

b. Administrative data storage and retrieval

Information networks could be used to reduce administrative paperwork. School administrators are burdened with reporting information to state and federal agencies on a variety of subjects: student and teacher personal data, attendance data, and financial reports. While a centralized computer storage and retrieval facility normally is available to state education agencies, the local school administrator still must operate in a paper-pencil-mail delivery mode, often delaying, for example, state-level decisions on financial aid to the school.

c. Electronic mail

Information networks could be used to facilitate communications between state agencies and school personnel. State agency planning and school service personnel need to communicate frequently with many school personnel, counselors, administrators, school boards, citizen accountability committees, and teachers. The wideband distribution capability of satellite systems offers an economical alternative to travel. Regional centers could more readily interact with local schools on topical issues, trends, and concerns. For example, pending legislation could be transferred in hard-copy form, a resource unit on the subject of a school-community drug and alcohol program could be discussed, or a recommendation could be made in response to a question about a local needs assessment strategy.

2. Rural Education

Although the right to an education is guaranteed by the 5th & 14th Amendments, there are disparities in both the quality and availability of education between urban and rural America. Only through increased use of telecommunications can equal educational opportunity be extended to all Americans on an economical basis.

In 1970, slightly over half of the U.S. population 25 years of age and older had completed high school.<sup>15</sup> In rural counties (2,500 - 20,000 residents), the median years of school completed was a full two years below the national median.<sup>16</sup> Of the U.S. adult population, 10.7% had graduated from college in 1970 compared with 5% of the population in rural counties. The disparity of educational opportunities, as reflected by level of educational attainment in metropolitan and non-metropolitan communities, is contrasted in Figure IV.1.<sup>17</sup>

Figure IV.1 Level of Educational Attainment (1970)

Level of Educational Attainment	Metropolitan Areas (population - 50,000 or more)	Non-Metropolitan Areas (population - 50,000 or less)	Total U.S. Population.
Population 25 years and over	80,126,000	29,773,000	109,899,000
Percent by level of school completed:			
less than 5 years of elementary school:	4.9	7.3	5.5
less than 1 year of high school:	25.5	36.0	28.3
4 years of high school or more:	55.1	45.0	52.3
4 years of college or more:	11.9	7.4	10.7
Medial years of school completed:	12.2	11.2	12.1

A report issued by the Economic Research Service of the Department of Agriculture entitled "Social and Economic Characteristics of the Population in Metro and Nonmetro Counties, 1970," states:

*"The completion of a high school education is a basic determinant of income and employment opportunities. The high school diploma has become recognized in recent decades as a minimum requirement for placement in a growing number of occupations. Hence, the percentage of 16-to-17 year olds enrolled in school is an indicator of the future employability of an area's population as well as the types of careers these residents might expect to achieve." 18*

The percentage of 16-to-17 year olds not enrolled in school was 10% in 1970 -- 9.5% in metropolitan areas and 13.6% in nonmetropolitan areas.<sup>19</sup> The report concludes:

*"Findings indicate that the population of totally rural non-metropolitan counties, compared with that of other counties, has a relatively low level of current socioeconomic status and future potential." 20*

The Office of Technology Assessment completed a recent study entitled "The Feasibility and Value of Broadband Communications in Rural Areas," which found that:

*"Major factors which influence quality and access to rural education are: economic characteristics of the community and the organizational structure of educational systems. The importance of economic characteristics lies in the fact that major financial support for education comes from the local community. On a national basis, financial support for public elementary and secondary schools is derived from the following sources: 53% from local funds; 38% from state funds; 9% from federal funds." 21*

Rural communities have a lower per capita income and a higher incidence of poverty than metropolitan areas. In 1970, the median family income in metro areas was \$10,406; it was only \$7,615 in non-metro areas.<sup>22</sup> The percentage of the population living in poverty in 1969 was 11.3 in metro areas and 20.2 in nonmetro areas.<sup>23</sup> Revenue for local school systems in non-metropolitan areas, if financed primarily by property taxes, would yield approximately 45% of the required resources versus the metropolitan average of 56%. Although 60% of the nation's substandard housing is in rural areas, only 20% of the federal housing assistance dollars are directed to this need.<sup>24</sup> The disparity is obvious. There is a limited tax base to generate local economic support of the educational system, and the federal support which logically should improve the rural tax base is being channeled into metropolitan areas.

Thus, educational systems in rural areas are plagued by a lack of funds and limited access to educational resources. Only by sharing resources can rural schools provide adequate services.

The economic climate in rural America is improving. Since 1970, population growth has been greater in rural areas than in urban areas of the U.S. During the four-year period from 1970-74, a net of 1.6 million persons moved into non-metropolitan areas, a 3% increase over the 1970 base population of 54.3 million persons.<sup>25</sup> Families with younger children are moving into rural areas. The median age of the population in growing rural communities is almost two years less than that of declining communities. Although the tax base to support the rural schools is increasing, this sudden influx of people has created a burden on existing facilities.



Any program or service available in the cities could be adapted for use in rural schools. But new methods for serving the educational needs of rural communities are needed.

The national commitment to equal opportunity is a basic tenet of democracy; and the need to upgrade educational programs, services, and teacher training in rural communities is moving toward a critical juncture. Currently there is momentum for change and new-found prosperity in some rural sections of the country. The Office of Technology Assessment concluded:

*"If these trends are further reinforced by circumventing fundamental rural problems of geographic isolation and low population density through the expanded use of communications, the opportunity might be at hand to help reach the national goal of more balanced growth." 26*

The prospects for applying telecommunications to alleviate the problems inherent in rural education are encouraging. However, to facilitate this process, an agent of change is required. There is a need for national leadership to provide structure to the various educational consortia which are developing.

### 3. Education for the Handicapped

The House Committee on Science and Technology reports that 40 million individuals, or 18% of the U.S. population, have a handicap.<sup>27</sup> Figures from the White House Conference on Handicapped Individuals reveal that at least 22 million individuals have physical handicaps and 6 million have mental handicaps.<sup>28</sup>

Individuals with mental or physical handicaps all too often are excluded from schools and educational programs, barred from employment, or are under-employed because of archaic attitudes and laws, denied access to transportation, buildings, and housing because of architectural barriers and lack of planning, and discriminated against by public laws.

The American public, in general, is simply unfamiliar with and insensitive to difficulties which confront individuals with handicaps. The failure to involve individuals with mental or physical handicaps in the development of programs which affect their lives fosters this problem. The public lacks adequate knowledge about the potential of these individuals to contribute significantly to society.

In the United States, there are an estimated seven million deaf, blind, mentally retarded, speech impaired, motor impaired, emotionally disturbed,

multiply handicapped, or other health impaired school-age children.<sup>29</sup> In addition, there are an estimated one million pre-school handicapped children who require special education programs.<sup>30</sup> These children represent approximately 10% of the school-age population, and although the number of handicapped children receiving special education services has increased, only about 40% of these children are receiving an education which is designed to enable them to approach their maximum capacity.<sup>31</sup> Additionally, there are an estimated one million handicapped children who are totally denied access to a free public education.<sup>32</sup> Further, there are an estimated 125,000 mentally retarded, emotionally disturbed, and physically handicapped children who live in state institutions where most education programs are inferior or nonexistent.<sup>33</sup>

In 1975, recognizing that almost one-half of the nation's eight million handicapped children were not receiving an appropriate education, the U.S. Congress enacted the Education for All Handicapped Children Act. A handicapped person's right to a good education is now guaranteed, but many districts are not yet in compliance with the law. The Rehabilitation Act of 1973 recognized the need for special training for handicapped persons and authorized the use of telecommunications, sensory devices, and other technological aids, in providing mandated services to handicapped individuals.

There are currently 130,000 teachers serving handicapped children between the ages of five and seventeen years of age.<sup>34</sup> To fully implement the right to education, 240,000 more teachers will be needed, and 60,000 required to meet the needs of the one million preschool handicapped children requiring services.<sup>35</sup>

Career education for the handicapped is also a need of paramount importance. A recent study, which projected the fortunes of handicapped adolescents four years after high school graduation, found that: <sup>36</sup>

- 40% were under-employed and living at the poverty level
- 26% were unemployed or on welfare
- 21% were employed or in college
- 8% were in their home communities and mainly idle
- 3% were totally dependent and institutionalized

These problems are magnified by the fragmentation of services for the handicapped. A Rand Corporation study found that of 16 social services required by the handicapped, nine were not the major responsibility of any one agency.<sup>37</sup> Programs for handicapped youth lack coordination and direction, despite large

yearly expenditures. One of the most serious faults pointed up by the study is that the programs do not even identify those eligible for the nearly \$5 billion of federal, state, and local funds. The report states: <sup>38</sup>

*"The sheer number of institutions dispensing funds and services contributes to a situation in which no one plans, monitors, or controls the handicap service system in any comprehensive fashion."*

The disparities and inequities are reflected by the fact that per capita expenditures for handicapped children in schools vary from a low of \$168 in some states, to a high of \$2,463 in others. <sup>39</sup>

Educational systems which employ the least restrictive environment concept try to provide a continuum of services in an unobtrusive manner. While exceptional persons have special educational and related needs, to the maximum extent possible, they should be educated with non-handicapped students. Placement in special classes, separate schooling, or other segregated programs should occur only when the student's educational and related needs cannot be provided in regular programs, even with the use of supplementary aids and services.

To support any comprehensive instructional delivery system there must be an array of special services and programs. As teachers individualize instruction for pupils and as schools provide more instructional services for individual pupils, there must be an effective system for delivery of special information and materials to teachers and pupils. Services include special transportation, special seats, electronic communications equipment for health and education, consultative services, instruction for homebound students when necessary, public information, etc. Access to services and programs not readily available, or difficult to justify because of geographic constraints or low incidence, could be shared with other communities through use of telecommunications.

#### 4. Migrant Education

Approximately 1.4 million people <sup>40</sup> in the United States are migrant workers; that is, agricultural laborers who move to find work wherever there is a seasonal demand. These migrants include Chicanos, Blacks, Indians, Puerto Ricans, and Anglos. They move in three broad streams from Florida, Texas, and California through forty-seven states. <sup>41</sup>

Predictions on the future magnitude of the "migrant problem" vary. At first glance, the migrant population appears to be decreasing as a result of the increased use of agricultural machines and the reduced need for field labor.

A closer inspection, however, reveals that the migrant population is growing because single male workers are being replaced by entire families. It is unlikely that this population will decline for at least ten to fifteen years.<sup>42</sup>

The problems and needs of migrant workers and their families probably have not increased in recent years, but the nation's concern for them has. The emergence of migrant spokesmen, a heightening consciousness of civil rights, and the publicity given to these issues, have all contributed to growing political pressures for programs to better serve migrant families.

The primary needs are common to all states with sizable migrant populations: adequate housing, basic health and nutritional services, appropriate educational opportunities, information regarding employment standards, and assistance. Although most states allocate resources to meet "primary" needs, funds are either unavailable or inadequate to address the educational needs of migrant children.

The U.S. Office of Education's Migrant Branch has an estimated \$130 million earmarked for education of migrant children in FY 77.<sup>43</sup> Ironically, eligibility is essentially limited to local and state education agencies, thus diminishing possible impact on interstate migrant requirements.

Fragmentation of services and programs at the state and local level further compounds the problem. In most states, it is unclear where responsibility for migrant services lies. The taxpayers in general, and employers in particular, are wary of providing additional services, which will entail restrictive state and federal regulations. Except in those states where migrants return after the harvesting season, the problem does, after all, disappear for much of the year.

In the face of these realities, relevant programs and services for the 500,000 migrant children<sup>44</sup> seeking an education are rare. The lives of migrant children are commonly unstable, uprooted and chaotic; their school attendance is likewise sporadic and inconsistent. Ninety percent of these children never finish high school and their average education level is fourth or fifth grade.<sup>45</sup>

The problem of providing services to migrant youngsters is national in scope, and interstate in nature. However, there is little likelihood that the necessary programs will be adequately funded either by the Federal Government or by individual states. Migrants pose an unique and complicated problem because they generally cross several state boundaries. In addition,

accurate data on their numbers and travel patterns are almost nonexistent. Intrastate workers -- those who may travel substantial distances but do not cross state lines -- may not be counted at all. In California, intrastate workers equal approximately two-thirds of the migrant population. In Texas, the number of intrastate workers exceeds 95% of the migrant population.<sup>46</sup> The Interstate Migrant Education Project, managed by the Education Commission of the States, is examining the educational problems of migratory children and will be formulating recommendations to improve programs and services to migrant populations.<sup>47</sup>

The first significant federal programs for migrant education were initiated in the mid-60s with the Economic Opportunity Act and the Elementary and Secondary Education Act. But the emphasis in these programs was on providing job development, job training, and permanent residences, not educational opportunities.

Those states with a substantial migrant population, of course, cannot overlook that group's special needs while other services are initiated and expanded. More effective use of telecommunication technology would expand and improve services and programs to the migrant population. The need for a relevant program plan, however, is a prerequisite. The most comprehensive plan to date is the California Master Plan for Migrant Education, which specifies national goals for migrant education.<sup>48</sup> Through use of satellites, facets of the California Master Plan could serve as a framework for programs developed in other regions of the country. To date, excluding isolated attempts to utilize mediated instruction, there has been little evidence of any concerted effort to apply labor-and cost-saving technology to the problems inherent in migrant education.

The Migrant Student Record Transfer System, an interstate system located in Little Rock, Arkansas, computes and analyzes information on the migrant population. The need for such a system is critical, since there is evidence that migrant children have been re-inneculated or re-tested because of a clinic's or school's inability to obtain updated records. Record keeping is a difficult problem. Usually the migrant family does not announce its arrival or departure, creating an additional time lag between arrival, identification of needs, and commencement of service delivery. Immediate access to a comprehensive

data base could enhance educational service delivery to migrant children by reducing duplication in record keeping and by providing continuity to the curriculum.

In addition to specific programs referenced above, there are also programs in certain states which are sponsored by various church organizations, health centers, the Office of Child Development, the Department of Labor, the Department of Immigration and Naturalization, and the Department of Agriculture, which could be enhanced by increased use of telecommunications. A prerequisite, however, is agreement on a comprehensive utilization plan.

In planning a demonstration program, it must be recognized that migrant streams are erratic in nature and extremely difficult to predict. It would be advisable to focus on one relatively stable migrant stream and to evaluate the practical difficulties of consolidating resources and services among the agencies which have territorial jurisdiction.

There is an obvious need for some mechanism to coordinate and aggregate the existing resources, and in turn provide a better means of service delivery to our migrant population. Once such a mechanism is established, appropriate use of telecommunications could dramatically upgrade the level of service while reducing the cost.

#### 5. Vocational Education

Vocational education, occupational education, and career education are the educational system's response to the information explosion. The intent is to better prepare today's students for an unpredictable future, a difficult if not impossible task. Preliminary indications reveal that classroom teachers are not adequately prepared to adapt current lesson plans to accommodate this new vocational emphasis. They need not only new knowledge and expertise, but also appropriate teaching materials. Mediated instruction could help, but its use has been limited.

Until there is role clarification among vocational, occupational, and career education disciplines, it is unlikely that the schools will be able to implement an effective program. The imprecise distinctions between the various aspects of these disciplines compound the problem, leading both to unnecessary duplication and unintended omissions in the curricula. The necessity

of vocational/career education programs has been recognized by the Congress in the Vocational Education Act of 1963 and the Amendments of 1968. The impact of this legislation is evidenced by the spectacular increases in enrollment, occupational programs, instructional personnel, and expenditures.

The 1963 Act substantially increased the level of federal support, and in 1975 the Federal Government accounted for \$584 million of the \$4 billion expended on vocational education.<sup>49</sup> Estimated federal support for FY 77 is \$594 million. The increase of federal funds has had a major affect on the growth of vocational education from 1963 to the present, which has seen an enrollment increase of 265%.<sup>50</sup> But the federal share of expenditures for vocational education has declined as state and local support has increased. Although total expenditures have increased, the rate of increase has diminished during the past three years.<sup>51</sup>

In most states there is a serious shortage of vocational education teachers, a situation which is growing more critical as enrollment continues to increase. The 47,000 school counselors now employed in the U.S. falls short of the number needed to implement the vocational/career education concept. In 1975, only 2.8% of all vocational education expenditures went to guidance and counseling.<sup>52</sup> Title II of the 1976 Educational Amendments Act, in an effort to alleviate this situation, mandated that not less than 20% of the funds available be used to support programs for vocational development guidance and counseling programs.<sup>53</sup>

One of the major tasks confronting educators is the need to change the image of vocational education. Too often, vocational education has meant auto mechanics for boys and home economics for girls. The focus must be broadened to reflect the reality of today and the promise of tomorrow.

Recent trends in vocational education enrollment show that among eight occupational service areas, office occupations had the largest net growth in 1974-75; trade and industry was second; consumer and homemaking was third; and agriculture was fourth.<sup>54</sup> However, the highest growth rate was in health occupations, which has shown consistently strong expansion for several years.<sup>55</sup>

Ironically, over 75% of the women in vocational education programs are enrolled in home economics or office occupations. Yet, women now comprise over 53% of the labor force.<sup>56</sup> A consequence of this disparity is an inordinately low median income for women in the U.S. labor force, whose average salary was \$7,719 in 1975 compared to the median salary of \$13,144 for men.<sup>57</sup>

Disadvantaged and handicapped students are two of the principal target groups which Congress intended to benefit through federal legislation supporting vocational education. Although the actual number of disadvantaged and handicapped students served has increased slightly, the percentage of these students in the total vocational education enrollment continues to decline. Two-thirds of all handicapped students in vocational education programs are enrolled in three areas -- trade and industry, home economics, and office occupations. The implication is that these students are destined for low or non-salaried careers.

Neither cooperative work experience nor work study is receiving more than passing attention from decision makers in vocational education. Work study programs are available primarily to help students attend school, and the work need not be related to their training. Funds have been severely restricted and vocational educators have had few opportunities to see if the program has long-term value. Cooperative work experiences also require additional funds, but more importantly they require a special effort on the part of instructional personnel to place each student with an appropriate employer. Class schedules are complicated, requiring adjustments by both vocational and non-vocational students and faculty. But cooperative programs are widely recognized as one of the most effective learning experiences.

Project Baseline recently completed a five-year study of vocational education entitled "Learning a Living Across the Nation."<sup>58</sup> This report found that the major weaknesses of vocational education today are lack of standardization, inequality of opportunity, lack of flexibility, neglect of work experience, and inadequate planning. Project Baseline recommended development of an automated data system to facilitate management and coordinate vocational education programs.

While this represents a necessary first step in fulfilling the goals of vocational education programs, increased utilization of telecommunications would permit access to job banks, access to specialists in exotic fields, specialized counseling and guidance, continuing education for professional staff, specialized pre-apprenticeship training and evaluation, self-assessment and testing opportunities, and decision-making and career exploration experiences.



No other educational program is more influenced by prevailing economic and social trends. To help adolescents train today for tomorrow's needs, current and accurate information regarding these trends is essential. Telecommunications and information networks have a vital role to play in the necessary reorganization of the system.

#### 6. Multicultural/Bilingual Education

America is a multi-ethnic society. It is a nation of many different peoples, who value their individuality, their culture, and their heritage. Minority groups in the United States comprise almost 18% of the population. There are approximately 23 million Blacks, 16 million people of Hispanic origin, 2 million Asian Americans (including Japanese, Chinese, Korean, and Filipino) and 800,000 Native Americans. More than 140,000 Indochinese refugees have also found homes in the United States.<sup>59</sup>

We live in an era of heightened national consciousness -- a new awareness of the value of cultural diversity. Accordingly, the educational system is being challenged to serve the needs of those who are culturally and linguistically different and who, historically, have not been adequately served.

Nationally, 26% of Blacks are two or more years below grade level; for Mexican Americans the lag is three years behind the white average in the twelfth grade; for Puerto Ricans it is 3.7 years; and for Indians it is 3.2 years.<sup>60</sup> Data on poor Black, Puerto Rican, Chicano, and Indian students show that they drop out of high school two to four times as often as Whites, they are suspended more often, and placed in programs for the "retarded" more than any other group.<sup>61</sup>

Schools fail students when curricula and textbooks ignore the experiences of minorities, when tests discriminate against the culture of minorities, and when teachers have low expectations of minority children, thereby stifling their drive to learn. Sensitivity and cultural awareness on the part of educators can make an enormous difference in a child's academic life, and educators must be prepared to deal effectively with cultural diversity. The task is to incorporate relevant cultural and linguistic experiences in our training and teaching -- and to share such resources when programs and services are limited.

Approximately five million children in the United States live in homes where a language other than English is spoken. The U.S., for example, is

the fifth largest Spanish-speaking population in the world. While some of these young people do speak English, between 1.8 and 2.5 million need special instruction in English. A fivefold increase in bilingual classroom teachers -- from about 800 at present, to 4,200 -- will be required. The existing bilingual/multicultural programs presently reach less than 5% of our non-English speaking children.<sup>62</sup>

Non-English speaking students encounter numerous problems in learning a second language, and these problems directly affect school achievement. Seventeen percent of the student population in the southwest is Mexican American, yet only 6.5% of the schools offer bilingual programs and only 2.7% of the pupils enroll in these classes. Arizona, Colorado, and New Mexico have less than 1% of their pupils enrolled in such classes.<sup>63</sup>

Recent court decisions have acknowledged the special needs of minority children. These rulings have specified that "equal educational opportunity" for children of non-English speaking backgrounds must include instruction in their native language. Nationally, there are bilingual programs providing instruction in Spanish, French, Chinese, Portugese, Filipino, and in Native American languages. However, there are simply not enough bilingual and minority educators to implement available programs effectively.

In 1967, Congress enacted the Bilingual Education Act in an effort to help local education agencies start programs to meet the needs of children who come from homes where the dominant language is not English. In FY 74, \$68 million was awarded to local education agencies. This supported 383 classroom demonstration projects in 42 languages and five materials development centers. Anticipated funds for FY 77 approach \$135 million.<sup>64</sup>

As a result of the Lau vs. Nichols decision, which found that the failure of the schools to provide linguistically comprehensive instruction for non-English speaking students was a denial of equal opportunity under Title VI of the Civil Rights Act of 1974, Congress authorized the establishment of resource centers to provide technical assistance to districts found in non-compliance with the law.

These General Assistance Centers, now referred to as Lau Centers, help local education agencies better serve their non-English speaking students.

Title VII, in addition to supporting bilingual education projects, also funds Emergency School Aid, Adult Education, Teacher Corps., Follow Through, Indian Education, and Right to Read. These programs, along with Headstart, also address the needs of the culturally and linguistically different, but only on a limited basis.

The major problems remain: the paucity of qualified teachers; inadequate pre-service and in-service training; and the need to recruit and train minorities to assume leadership positions.

The existing programs are limited and geographically separated. The projected funds for the near future will reach only a small percentage of those in need. An alternative is required that will enable those resource centers and those exemplary projects to coordinate and share effective programs in bilingual/multicultural education. Continuing education for professional staff also could be enhanced with access to resource specialists through the use of telecommunication technology.

It must be recognized that there are important differences between and within minority populations. These differences, such as different dialects, must be treated with sensitivity. Bilingual education will be difficult to administer to a mass audience. Individualization and personal understanding are essential ingredients of a successful bilingual education program -- indeed to education in general. The controversial nature of this field will complicate attempts to aggregate requirements and to utilize advanced telecommunications effectively.

#### E. Findings

The observations of this study were validated by a panel of experts, who were questioned individually. They were also asked to respond to a questionnaire which was designed to ascertain the status, requirements, and prospects of telecommunication utilization in their respective fields of study.

In general there was agreement that the six areas identified by PSSC (administrative and management services, rural education, education for the handicapped, migrant education, vocational education, and multicultural/bilingual education) were the most promising areas of public education to aggregate. There is an awareness in the educational community of the need for shared services and programs, but the major barriers to widespread implementation of any technological

innovation were stressed. There is a need among educators for greater familiarity and understanding of technology, its uses, educational applications, and limitations.

PSSC's major findings which resulted from numerous conversations with educational experts were that:

- .. The structure of the present system of public education in America, both economically and programmatically, appears to be inconsistent with the requirements of a broadly-based telecommunications network. Implementation of a comprehensive information network may face organized resistance and probably will take years to accomplish.
- .. Programs and services in rural communities reflect priorities in non-technical areas: e.g. housing, water, energy, jobs, roads. Although telecommunication technology could alleviate some of these problems, it is not seen as an important priority in its own right. Telecommunications is not interpreted to be a tool to solve problems, but rather to be a source of problems.
- .. Certification issues in some states and in some disciplines will restrict the use of telecommunication systems. Funding patterns perpetuate the traditional classroom unit which requires a certified person in each classroom to comply with funding regulations.
- .. Education needs ongoing services. There is a feeling that telecommunication alternatives are not yet viable possibilities, other than for demonstration.
- .. There is marked concern for experimental communication satellite capability to follow CTS and ATS-6. There is reluctance to invest in hardware when the future is so uncertain.
- .. Although there is agreement that federal funds are available, there are numerous problems that have to be resolved before funding can materialize. Most federal monies are funneled through state agencies and then to local agencies. Funding restrictions on capital outlays, duplication of efforts by different social service agencies, and the fickle nature of federal funding patterns perpetuate demonstrations and stifle ongoing continuous services.

- .. The typical educator is not prepared or able to make decisions of the magnitude necessary to incorporate the use of satellite technology in the public schools. Some outside agency will have to assume the leadership role. But no one agency is now structured to assume the leadership in planning and implementing a comprehensive distribution system.
- .. The educational community is not organized to propagate innovation. There is widespread awareness that innovation, per se, does not necessarily improve quality or reduce costs. A very good case and tremendous patience will be required to aggregate the resources and requirements of the educational community. The federal government or some other outside funding agency will have to subsidize the use of telecommunication technology in the public schools initially.
- .. A positive attitude on the part of school administrators is of paramount importance in gaining acceptance.
- .. School administrators generally have an interest in technology, but are apprehensive about the ramifications of its widespread use. Will telecommunications really improve the quality of education and reduce the cost? If so, how can the enormous organizational and budgeting problems be managed during the transition from the traditional classroom unit?
- .. Several administrators were not positive about an interactive information system. The use of phones, they felt, would be more convenient and less expensive. The question of access relates to end-to-end access to relevant information. If a satellite system were now linked to relevant sources of information, attitudes would be much more positive.
- .. There is a general feeling among educators that the cost of using communication satellites in education will be prohibitive.
- .. Available funds for use of technology in support of administration and management are limited. The identified funding sources would require line-item manipulation. (Appendix IV.B)
- .. In extended distribution of mediated programs, copyright restrictions may present an insurmountable problem.

- .. Multicultural education is too political and is losing its base of support. More focus on bilingual education is likely to occur.
- .. Unless there are some fundamental changes in the educational system today to accommodate telecommunication technology, communication satellites will not be utilized effectively by the educational community.

#### F. Possible Funding for Demonstration Projects

Substantial federal funding already is available to support innovation in education. The sources which are summarized in Figure IV.2 were selected to correspond to the six areas of activity which are described in this chapter, and do not exhaust the possibilities. It is assumed, for discussion purposes, that federal education expenditures will rise at 5% a year and that 1% of the projected FY 79 expenditures could be available to support demonstration projects. A breakdown of these funding sources appears in Appendix IV.B.

FIGURE IV.2. PROJECTED FEDERAL FUNDS FOR DEMONSTRATION PROJECTS

<u>Selected Area</u>	<u>1% of Selected Federal Funds FY 79</u>
Bilingual Education	\$ 2,800,000
Handicapped Children	4,200,000
Administration, Organization & Management	6,700,000
Vocational Education	2,100,000
Rural Education	4,700,000
Migrant Education	22,000,000

What demonstration projects would be most appropriate? The answer to this question depends on what consensus, if any, emerges from discussions with federal, state, and local agencies having primary concern with education. PSSC's recommendations appear in the next section.

Approximately what level of equipment support would be appropriate? Strictly for purposes of discussion, Figure IV.3 summarizes PSSC's intuitive estimate of a reasonably sized demonstration in any of the six areas discussed in this chapter. Note that if a system is established to perform any one of these six functions on a comprehensive basis, the marginal cost of performing any of the remaining functions will drop markedly. A discussion of system alternatives for a Public Service Communications Technology Satellite program appears in Chapter VII.

FIGURE IV.3. PROJECTED EQUIPMENT REQUIREMENTS  
IN SELECTED AREAS OF EDUCATION, 1979-80

Area of Education	Required No. of Receivers		Capability Required					
	Min.	Max.	One-Way			Two-Way		
			Data	Audio	Video	Data	Audio	Video
Migrant <sup>1</sup>	24 6 2	36 10 4			F	T F F	T F F	F
Bilingual <sup>2</sup>	12 12	18 24			T	F T	F T	F
Handicapped <sup>3</sup>	18 50 50	24 100 100			F T	F F T	F F T	F
Vocational <sup>4</sup>	10 100 50	20 200 100			F T	F F T	F F T	F
Administration <sup>5</sup>	480	960				F	F	
Rural <sup>6</sup>	200 50	400 100			F T	F T	F T	

T - Transportable receiver

F - Fixed receiver

<sup>1</sup>Selected migrant centers in one migrant flow are assumed to be interconnected.

<sup>2</sup>LAU Centers throughout the U.S. are assumed to be interconnected.

<sup>3</sup>The Area Learning Resource Centers/National Center on Educational Media and Materials for the Handicapped Network are assumed to be interconnected.

<sup>4</sup>State vocational centers are assumed to be interconnected.

<sup>5</sup>There are over 16,000 school districts in the U.S; 3%-6% are assumed to be interconnected.

<sup>6</sup>There are over 4,000 school districts with less than 300 students; another 4,000 districts have less than 1,000 students; 3%-6% are assumed to be interconnected.

## G. Recommendations

PSSC is not prepared at this time to recommend a single point of entry to the educational system and is hesitant to prioritize the alternatives which have been examined. There is a need for further discussion among potential sponsors and users to establish priorities.

Once a satellite system is established to serve one of the six areas which are evaluated in this chapter, the remaining five areas will follow naturally. It may develop, for example, that an information network which serves rural school superintendents is a feasible first step. Information networks which were designed for administrative purposes easily could be adapted to support programs in education for the handicapped, vocational education, and migrant education. Bilingual education will benefit when it becomes feasible for school districts to share specialized resources.

Based on the comments of the panel of experts, a review of the literature, and prior experience, PSSC makes the following recommendations to NASA:

- .. Recognize at the outset that the structure of the traditional educational system is inconsistent with the requirements of a national or regional telecommunications system. One must exercise great caution in selecting entry points to the system.
- .. Identify some educational agency with a national base to assume responsibility for planning, developing, and implementing communication satellite demonstrations, e.g. National Education Association, Council for Exceptional Children, or the American Association of School Administrators. Encourage this agency to indicate in detail how the proposed system will improve the quality and/or reduce the cost of the educational function under consideration.
- .. Convene a meeting of the federal agencies who support one or more of the selected educational areas to discuss the baseline plan and to initiate cooperative funding efforts.
- .. Convene a meeting of appropriate state agencies to discuss the baseline plan and to develop a state strategy for aggregating services in one or more of the selected areas.



- .. Develop a public relations program to encourage awareness, acceptance, understanding, and utilization of telecommunications in education. Pay particular attention to the administrators in education, whose support is crucial to acceptance of new programs.
- .. Loan transportable origination and receiving equipment for extended periods of time to promote acceptance and use.
- .. Convene a meeting with representatives of state certification agencies and professional associations to discuss alternative certification and licensing requirements.
- .. Select a qualified organization to examine and interpret the copyright laws, identify problems which may impede successful implementation of an educational telecommunications system, and suggest appropriate measures to overcome these problems.
- .. Develop an informational program to demonstrate how increased utilization of telecommunications could alleviate some of the problems of rural communities.

#### H. Conclusion

It is unlikely that telecommunications will be utilized extensively in elementary and secondary education in the absence of fundamental organizational changes. Use of appropriate labor-saving technology probably would result in productivity gains, but first there must be coordinated planning and agreement on the basic objectives which are to be addressed in related fields of education.

Facilitating innovation in education is an exceedingly complicated business. Problems of certification, licensing, funding, civil rights, and collective bargaining must be resolved before telecommunications can be utilized extensively by the public schools. A major objective of this study was to determine where to begin the necessary but elusive process of change.

Any one of the six areas discussed in this chapter may prove to be the most appropriate entry point. PSSC conjectures that management information systems will prove to be a useful and acceptable initial application of telecommunications. Information networks could be used to provide computer-based instruction, administrative data storage and retrieval, and electronic mail. A promising initial application would be in support of rural school superintendents.

This conclusion is highly tentative and is contingent upon the identification of an appropriate agency with a national base to assume responsibility for planning and implementing such a system.

American education should be a principal beneficiary of the fruits of the Age of Information. The computer and communications networks have given mankind powerful tools to aid in the quest for new knowledge and the endless challenge to better utilize our innate gifts. Telecommunications and computers eventually will revolutionize the fundamental process of cognition, and American education should be at the forefront of this evolutionary development. There are encouraging signs that the educational community is becoming increasingly open minded about the potential benefits of information technology.

But institutional change occurs slowly. Past efforts to introduce change in education have suffered from being "not a part of" but "apart from." There is a need for an agent of change with strong local support to assume the leadership role in promoting telecommunications utilization in the public schools.

APPENDIX IV.A.  
QUESTIONNAIRE  
DISCUSSION GUIDELINES

1. What kinds of services do telecommunications render well?
2. Would telecommunications enable you to gain access to resources not otherwise available?
3. What common needs of your institution might be addressed through aggregation?
4. What are the factors which mitigate against use of telecommunications technology?
  - certification
  - civil rights issues
  - licensing requirements
  - ideological imposition (cultural awareness)
  - non-compliance with existing mandates
  - funding and budgetary restrictions
  - costs
  - scheduling
  - low productivity
  - accountability and quality control
  - relevant programs
5. Suppose a telecommunication service was available for your institution. What would it take to get approval for the organization to purchase the service?
6. How do you determine the acceptance and effectiveness of telecommunications?
7. How are communication decisions made regarding the use of media, telecommunications, and printed matter?
8. Overall, would you say the prospects for the future are good, fair, or poor with regard to the use of new technology such as telecommunications?

## APPENDIX IV.B.

### FEDERAL FUNDING SOURCES AND PROJECTED GROWTH

The funding sources outlined below were selected to correspond to the six educational fields described in the report. No attempt was made to exhaust the possible sources; the intent, rather, was to provide an awareness of the diversity of federal funds relating to education and training. Other federal funds in non-education-related fields are also available to support satellite service delivery; e.g., Department of the Interior, Department of Agriculture, Department of Defense, National Institute of Health, Social Security Administration, etc.

For discussion purposes, projections are based on selected funding sources in related fields of education to demonstrate that there are adequate funds available.

The following growth projections focus primarily on federal funding sources. The federal contribution is approximately 10% of total expenditures for education.\* The initial projections for education involvement are based at 1% of the federal contribution. In effect, projected growth in dollars for communication satellite delivery would begin at 1/10 of 1%, and after ten years would not exceed 1% of the total dollar expenditure for education.

The projected growth may vary among educational disciplines depending on needs, requirements, interests, priorities, attitude, and resources. Using the estimated FY 77 dollar expenditure for education of approximately \$119 billion, the prospects of generating support in excess of \$119 million, or 1% of the Federal expenditure, are most encouraging, but perhaps misleading since we are including all educational expenditures; considering only the six selected areas described in the report would generate approximately \$4.2 million using an estimated 1/10 of 1% of Federal expenditures.

The dollars are there; how to mobilize and aggregate the support remains the challenge.

\*Estimated percentage of expenditures:

	All Levels	Elementary/Secondary	Higher Education
Federal	10.7%	8.0%	15.2%
State	33.7%	36.2%	29.3%
Local	30.5%	45.9%	4.5%
Other	25.1%	9.9%	51.0%

Appendix IV.B. (cont.)

BILINGUAL EDUCATION

	Estimated FY 77
P.L. 93-380, Bilingual Education Act, Title VII:	
Bilingual Education Training Program	\$ 9,275,000
Bilingual Education R&D	90,000,000
Bilingual Education Fellowship	4,000,000
Basic Program of Bilingual Education	70,725,000
Bilingual Education Training Resource Centers	} 11,050,000
Bilingual Education Materials Development Centers	
Bilingual Education Dissemination/Assessment Center	
P.L. 90-576, Vocational Educational Amendments:	
Bilingual Vocational Training	2,800,000
P.L. 91-230, Adult Education Act:	
Adult Education	67,500,000
P.L. 92-318, Elementary and Secondary Education Act:	
Ethnic Heritage Studies	<u>2,300,000</u>
TOTAL	\$257,650,000

HANDICAPPED CHILDREN

	Estimated FY 77
P.L. 91-230, Education of the Handicapped Act:	
Preparation of Professional Personnel	\$ 41,375,000
Handicapped Children Early Education Program	22,000,000
Grants to States for the Education of the Handicapped	110,000,000
Media Services and Captioned Films	16,000,000
Handicapped Research and Demonstration Programs	11,000,000
Education of Handicapped Children in State Schools	109,000,000
 P.L. 93-380:	
Gifted and Talented Children	2,560,000
 P.L. 90-248, Social Security Act:	
Research in Maternal and Child's Health and Crippled Children Services	4,400,000
 P.L. 94-103, Developmentally Disabled Assistance Act:	
Formula Grants to States for Programs for the Develop- mentally Disabled	33,058,000
Special Projects for the Developmentally Disabled	16,317,000
 P.L. 93-112, Vocational Rehabilitation Act:	
Vocational Rehabilitation Projects and Demonstrations	<u>18,000,000</u>
 TOTAL	 \$383,710,000

Appendix IV.B. (cont.)

ADMINISTRATION, ORGANIZATION, AND MANAGEMENT

	Estimated FY 77
P.L. 92-318:	
Research in Education (NIE)	\$ 78,300,000
Emergency School Aid Act	202,100,000
P.L. 88-352, Civil Rights Act, Title IV:	
Desegregation Programs for Public Education Agencies	34,700,000
P.L. 89-329, Higher Education Act:	
Strengthening Developing Institutions	110,000,000
P.L. 93-380, Title IV:	
Community Education Program	1,777,000
Educational Innovation and Support	<u>184,521,852</u>
TOTAL	\$611,398,852

VOCATIONAL EDUCATION

	Estimated FY 77
P.L. 90-576, Vocational Education Amendments, Title I: State Vocational Education Programs and Services	(\$481,530,000)*
Exemplary Projects in Vocational Education	8,000,000
Applied Research in Vocational, Occupational, and Technical Education	26,751,500
P.L. 93-380, Title IV: Career Education Program	10,135,000
P.L. 91-596:	
Occupational Safety and Health Research	1,900,000
Occupational Safety and Health Training	3,000,000
P.L. 93-112, Vocational Rehabilitation Act: Vocational Rehabilitation Projects with Industry	18,000,000
P.L. 87-415, Manpower Development and Training Act, Title I: Experimental Manpower Program	12,323,000
Research and Evaluation of Manpower Problems	
P.L. 67-85, Synder Act of 1921: Career Development for Indians	34,425,000
Adult Education for Indians	2,683,000
P.L. 78-16, Veterans Vocational Rehabilitation Benefits Act: Vocational Rehabilitation of Disabled Veterans	<u>77,460,000</u>
TOTAL	\$194,677,500

\*not included in total



## MIGRANT EDUCATION

### P.L. 89-10, Title I:

Education of Migrant Children	\$ 130,000,000
Education of Children from Low Income Families	1,725,271,000
Libraries and Learning Resources	147,330,000

### P.L. 89-329, Title V:

Teacher Corps	<u>37,500,000</u>
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TOTAL	\$2,040,101,000
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### Examples of Other Federal Agencies Providing Migrant Information and Services:

- Department of Agriculture
- Social Security Administration
- Department of Labor
- Department of Housing and Urban Development
- Equal Opportunity Commission
- Immigration and Naturalization Service

Appendix IV.B. (cont.)

RURAL EDUCATION

	Estimated FY 77
P.L. 87-749; Cooperative Extension Service	\$182,991,720
P.L. 92-419; Rural Development Act	
P.L. 89-136, Public Works and Economic Development Act: Technical Assistance with Economic Development	6,000,000
P.L. 73-167, Johnson-O'Malley Act: School District Aid to Educate Indians	27,952,000
P.L. 94-188, Appalachian Regional Development Act	26,400,000
P.L. 73-416, Communications Act of 1934: Noncommercial Educational Broadcasting Facilities	1,000,000
P.L. 85-568, National Aeronautics and Space Act: Space-Related Education Services	does not involve funding
Services of the National Audiovisual Center	does not involve funding
P.L. 89-209, National Foundation on Arts and Humanities Act: Special Programs and Projects in the Arts	75,826,900
Education Programs in the Humanities	15,700,000
Public Programs in the Humanities	7,800,000
Research Programs in the Humanities	10,500,000
P.L. 81-507, National Science Foundation Act: Technological Innovations in Education	not yet determined
Research Applied to National Needs	61,300,000
P.L. 93-113, Domestic Volunteer Service Act: ACTION	not yet determined
VISTA	<u>13,600,000</u>
TOTAL	\$429,070,620

All funding sources outlined in the five areas apply to rural education.

## CHAPTER IV

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## CHAPTER V

### KNOWLEDGE RETRIEVAL

#### A. Introduction

To serve their patrons more effectively, libraries have begun to experiment with procedures which will enable them to provide information to the user when and where he needs it, an objective impossible to attain with traditional techniques. Computer and communications technology have advanced to a point where publishable research results often appear in a data base before they are distributed as hard copy. In the next 25 years, on-line interrogation of distributed data bases will replace browsing through card catalogs and library stacks for those organizations which can afford the cost of access. In time, individuals will be free to concentrate on synthesizing information, rather than memorizing it.

Librarians may be excused, however, for expressing skepticism in response to predictions of an imminent "Golden Age" of information. Susan Martin, writing in the Library Journal, offers a sobering perspective:<sup>1</sup>

*"In the early 1950s, computer technology invaded the industrial and commercial worlds. The information community was no exception. With the operating speeds and flexibility of the computer, very little seemed to be beyond accomplishment. The "Red Book"<sup>2</sup> which described the future of automation at the Library of Congress is an outstanding example of one attempt to explore the capabilities of this new technology; like others, however, the authors were not able at that time to grasp the complexities of the task they were proposing. The early flush of power felt by the information professionals gave way within a few years to a cynicism born of multiple failures, poor planning, and inadequate funding.*

*In the next few years, we will witness a spiral rather than a cycle. The initial enthusiasm for the potential of the new technologies to assist us in handling information will return. However, the intervening experiences with technology, the self-evaluation of the early 1970s, and tight economic conditions will prohibit a return to the starting point. This time, development efforts will slowly and carefully spiral our traditional approaches to information from the posture of the past centuries to one which will take increasing advantage of the unique and special characteristics of a computer-based technology."*

There are now 26,733 libraries in the United States and 3,064 in Canada.<sup>3</sup> These totals include libraries having collections of at least 10,000 volumes and are broken down by category in Table V.1. The total expenditures of U.S. libraries in 1976 amounted to approximately \$4.4 billion. Public, college,

and university libraries spent an estimated \$468 million on new acquisitions in 1976, of which only 32 million was spent on audio-visual or microform materials.<sup>4</sup>

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Table V.1. Composition of Libraries in U.S. and Canada (Ref. 3)

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A. United States

Public libraries	8,504
Branch libraries of city, county, and regional systems	5,477
University & college libraries	1,696
Junior college libraries	1,129
Special libraries in university & college systems	1,252
Other special libraries	6,563
Medical libraries in university & college systems	157
Other medical libraries	1,955
Total	26,733

B. Canada

Public libraries and branches	1,752
University, college & junior college	228
Special libraries of all types	1,084
Total	3,064

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American libraries experienced their greatest period of growth and affluence in the 25 years following World War II, a growth which peaked in 1970 and which has been declining ever since. Meanwhile, the exponential generation of new information, the increasing requirements for storage, and the diminishing amounts of available space have placed unrelenting demands on the library. Recognition of the impossibility of accommodating increasing demands for service in the face of diminishing resources and higher costs resulted in a reassessment of institutional objectives and management procedures during the 1970s.

To what extent will the process of knowledge retrieval change in the 1980s? Information in and of itself is without value. It must be communicated to be used. Top managers, policy makers, and scientists prefer to obtain information directly from other high-level people. But most people do not have direct access to individual experts. They must rely upon recorded information and must often be



resourceful in locating a proper source. In searching through files of recorded information, one first retrieves references, not the desired facts and knowledge. One usually must evaluate several sources and dig out many facts before gaining the knowledge which one could have obtained in minutes given direct access to an expert.

Until this decade, the goals of fact and knowledge retrieval appeared to be unreachable. Computers were too slow and too expensive, large data bases were nonexistent, and networks to interconnect data bases economically did not exist. All this has changed dramatically in the past years, and technological advances on the horizon will bring even more drastic changes. Some of the anticipated changes include: video discs to hold the contents of books but costing less than paperbacks; hand-held readers and terminals; networks which interconnect data bases containing not just bibliographic records but data, facts, and full text material in both digital (manipulable) and video form for transmission; new computer architectures; low-cost mini-computers and "smart" terminals; and data communications service capable of transferring masses of data at costs below those of the U.S. Postal Service.

This chapter summarizes the major trends in information retrieval and describes how the American library community is adjusting to incorporate these developments.

#### B. Status of Library Networking Activities

Information networks have not, as yet, gained widespread acceptance in the U.S. library community, Martin notes.

*"Thus far, network implementation in libraries has been aimed chiefly at automation of manual procedures, rather than at fundamental change in the use of the library by staff and patrons."*<sup>5</sup>

The leisurely pace of innovation may be attributed to several factors. For one thing, there is a lack of data regarding mission, process, and cost for all but the so-called "technical service" procedures in the library.\*

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*\*Librarians define "technical services" as the "backroom" operations, such as cataloging and acquisitions, that do not involve direct contact with the patron.*

This lack of baseline data makes it difficult for librarians to evaluate objectively the costs and benefits of nontraditional procedures which might enable the average library patron to retrieve information more conveniently and efficiently. A commentary regarding barriers to acceptance of information networks appears in sections F.7 and G.

A 1971 study<sup>6</sup> identified eleven library functions which are amenable to computerization: cataloging, serials control, information retrieval (the only item of the list which is not a technical service), acquisitions control, circulation control, inter-library loans, control of archival material, production of indexes, inventory control, record keeping, and registration. There has been intense development of all eleven service categories in the 1970s, and each are in varying degrees of operational readiness.

Cataloging is the largest "technical service" cost in a typical library.<sup>7</sup> For over a century, librarians have recognized that cataloging costs could be reduced dramatically if it were possible to catalog a book once and then share that information with other libraries. The Library of Congress began selling copies of its catalog cards at the cost of the cards and postage in 1901. More recently, on-line availability of catalog information has reduced the distribution delay and has increased the number of libraries which are capable of cataloging a book. Participating libraries usually find that a new acquisition already has been cataloged when they access the central data base of bibliographic records. They then instruct the national service center to print and mail the necessary catalog cards, which can be tailored to meet individual requirements.

The largest national service center is the Ohio College Library Center (OCLC) in Columbus, Ohio which serves approximately 850 libraries in 44 states. Participating libraries in OCLC's network cataloged 5,707,828 books in 1975-76, and OCLC printed 39.6 million catalog cards.<sup>8</sup> The OCLC data base contains more than one-and-a-half million bibliographic records and is growing at a rate of more than 15,000 records per week.<sup>9</sup> In mid-1976, OCLC operated with two central processors (CPUs) which serviced some 1,200 terminals, but response time became as long as 25-30 seconds. A new configuration which utilizes four CPUs has been implemented, which is capable of handling 2,700 terminals with an average response time of less than eight seconds.<sup>10</sup> It should be noted that at current

prices, 2,700 OCLC terminals (which cost \$3,700 apiece) will represent a capital investment of almost \$10 million.<sup>11</sup>

There is evidence that OCLC's on-line cataloging service has increased productivity. A study of the Cornell University library system revealed that it takes an average of 3.96 minutes to catalog a book using the OCLC system. By comparison, it takes 13.49 minutes to do this same job with only Library of Congress materials, and 35.96 minutes if the librarian is forced to generate the bibliographic record on his own.<sup>12</sup>

Serials control is the only other service now offered nationally by OCLC. About 200,000 bibliographic records for serials are expected to be on file by the end of 1977.<sup>13</sup> In addition to providing cataloging information, OCLC maintains a data base to alert the subscriber when to expect the periodical and upon request will mail a letter to the publisher requesting a late copy. OCLC also keeps tabs on billing information, alerting the customer when his subscription is about to expire.

The BALLOTS (Bibliographic Automation of Large Library Operations Using A Time-Sharing System) center at Stanford University provides a broader range of services to a smaller number of libraries. The BALLOTS data base contains more than 600,000 records and is growing at a rate of 3,000-to-4,000 records per week. Originally developed to serve just Stanford University; BALLOTS is in the process of extending its services throughout California. Approximately 30 institutions are now on-line.

Library networking activities are well documented by Martin<sup>14</sup> and by Avram and Maruyama<sup>15</sup> representing the Network Advisory Group of the Library of Congress. Avram and Maruyama's study is especially useful because it groups computerized networks into organizational and functional categories. These are:

1. Bibliographic utilities -- organizations such as BALLOTS and OCLC which maintain large, on-line data bases to provide processes and products to libraries and library users and whose purposes include cost-reduction and resource-sharing. Other examples are the Washington Library Network (WLN) and the Research Libraries Group (RLG).
2. Multistate service centers -- organizations which were established to reduce library operating costs and to improve

services and access through library cooperation. These regional centers implement computer-based services from one or more of the bibliographic utilities and commercial vendors. They may also operate other reference and bibliographic services or provide education and training in the use of bibliographic utilities. Some centers are developing technical components such as message concentrators to provide improved distribution of vendor services to individual members. Examples of centers are the New England Library Information Network (NELINET), Southeastern Library Network (SOLINET), AMIGOS Bibliographic Council, Midwest Region Library Network (MIDLINET), Bibliographical Center for Research (BCR), Pacific Northwest Bibliographic Center (PNBC), and Pennsylvania Area Library Network (PALINET).

3. Statewide, intrastate service centers -- similar to those described in (2) above. In many cases, these centers rely on computer-based bibliographic services provided by larger jurisdictions or directly from bibliographic utilities. Examples are the California Library Authority for Systems and Services (CLASS), Indiana Cooperative Library Services Authority (INCOLSA), Five Associated University Libraries (FAUL), Pittsburgh Regional Library Center (PRLC), Illinois Library and Information Network (ILLINET), New York State Inter-library Loan Network (NYSILN), Minnesota Inter-library Teletype Exchange (MINITEX), and some components of the Washington Library Network (WLN).
4. Resource libraries -- which are so large, complex and special that they are regional or national resources which should be accessible under specific conditions to a large number of users. Examples are the libraries of the University of Chicago and Stanford University.
5. Federal library network activities -- coordinated by the Federal Library Committee. Projects include the establishment of a telecommunications system, a feasibility study for a government documents data base, and an assessment of the utility of mini-computers for federal library applications. The Federal Library and Information Network (FEDLINK) operates like a multistate service center.
6. Council of Computerized Library Networks (CCLN) -- membership consists of 24 library consortia, regional groups, or library networks.
7. National libraries -- includes the extensive networking activities of the National Library of Medicine and the agricultural sciences information network of the National Agricultural Library.
8. Information retrieval services -- available from commercial firms which provide on-line access to 350 or more data bases, most of which contain bibliographic citations.

9. Other private sector organizations such as vendors and publishers engaged in the production, processing, and distribution of information.
10. Communication carriers -- including value-added networks (e.g., TYMNET, TELENET) and other common carriers.

Additional descriptive information about specific networks can be found in some of the already cited materials, in regular issues of the Journal of Library Automation, and in special publications such as Library Technology Reports. Speculation about future library network models -- under the assumption that satellite data communication service will have little impact -- is offered by Aronofsky and Korfhage.<sup>16</sup> The possible impact of satellites is discussed in Chapter VII of this report.

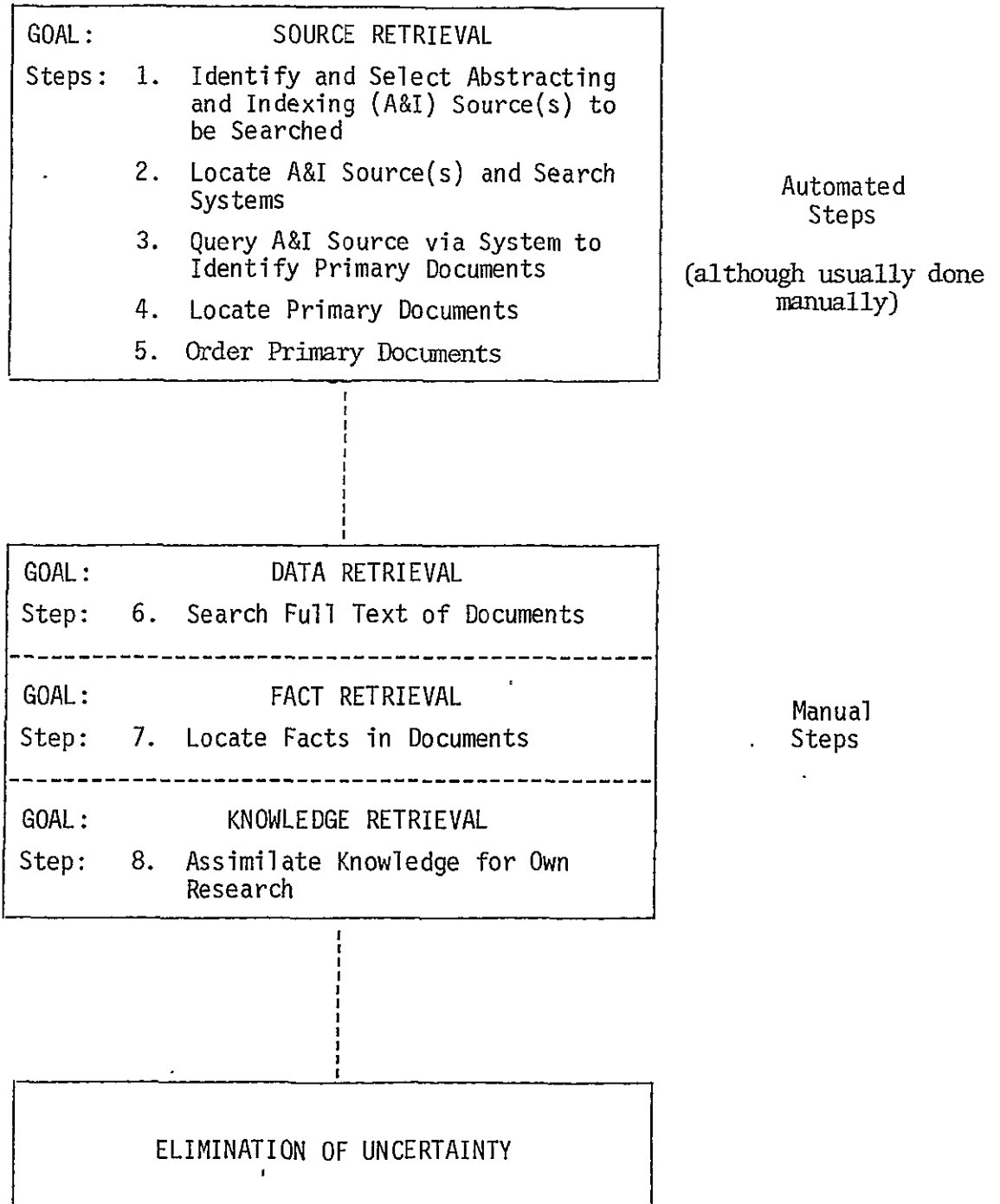
### C. Status of Information-Retrieval Activities

The evolution of information-retrieval services will bring computers out of the back office into the mainstream of library activities -- where the librarian and patron directly interact. The retrieval of information begins where the publishing of primary (e.g. books, journals, etc.) and secondary products (e.g. abstracting and indexing services) ends. Retrieval is concerned with accessing and retrieving recorded information regardless of the media (e.g., hard copy, microform, computer-readable, or video format) on which it is recorded. Retrieval goals progress from the retrieval of information sources, through information and data, to facts and knowledge, with the ultimate goal being the elimination of uncertainty. The higher level the retrieval goal, the less automated the retrieval process.

Referring to Figure V.1, eight steps can be identified in the information retrieval process.<sup>17</sup> The first five of these steps are associated with source retrieval, and it is only these aspects of the process which are automated to some extent today. But even these "source retrieval" steps usually are performed manually, and the last three steps must be performed manually. The nature of the research which is being conducted to automate these higher level activities and to gain increased user acceptance is discussed in Section E.

The majority of the world's currently published abstracting and indexing literature is in computer-readable form. There are more than 350 publicly available bibliographic data bases which contain more than 50 million records.<sup>18</sup> More than 75% of the computer-readable bibliographic records are now available through

FIGURE V.1. STATE OF THE ART OF INFORMATION RETRIEVAL (Ref. 17)



the various on-line system vendors in the U.S., Canada, and Europe. Major vendors include: the National Library of Medicine (MEDLINE, TOXLINE, CATLINE), Lockheed Information Service (DIALOG), System Development Corporation (ORBIT), Bibliographic Retrieval Service (STAIRS), the Canada Institute for Scientific Information (CAN-OLE), and the European Space Agency (RECON). Access to the data bases, through the on-line vendors, are provided by dozens of centers, libraries, and information brokers. An estimated 1.2 million retrospective searches were conducted in 1976.<sup>19</sup>

Information services that are now being provided on-line to users include the following:

- Retrospective searches
- Current awareness searches
- Numerical data retrieval
- Fact retrieval
- Question answering
- Library selection and acquisition
- Library reference service
- Library cataloging
- Location of library resources
- Document ordering
- Referral of users to data base resources and services
- Referral of users to people, places, and conferences
- News announcements
- Electronic mailboxes<sup>20</sup>
- Teleconferencing<sup>21</sup>
- Data base transfer within networks
- Personal data base maintenance
- Facsimile transmission
- Teletext (television search system)<sup>22</sup>

#### D. Trends Affecting Knowledge Retrieval

The entire publication/knowledge retrieval process, starting with the creation of information by authors through processing, distribution, storage, access, and retrieval of the primary and secondary information in hardcopy, microform, or computer-readable form, will change considerably in the next decade as new technologies are adopted. Trends in technology may be grouped in terms of computer processors, terminals, storage, publishing, data bases, and software. Each of these topics will be addressed individually.

Telecommunications will be utilized extensively throughout the information process, from its creation to subsequent retrieval. A rule of thumb in the information industry is that telecommunications accounts for 10% to 15% of the total cost of an information service. Thus, although reductions in the cost of

data communications service are expected, due to the development of satellite communications and competition among specialized common carriers, the end-to-end cost of information services is unlikely to be influenced substantially as a result. In establishing R&D priorities, one must focus on the desired end-to-end process, not simply the element of telecommunications, or more specifically, the communication satellite.

#### 1. Computer Processors

The history of computers and computing was reviewed by Ruth Davis, then with the National Bureau of Standards, in March, 1977.<sup>23</sup> Her analysis illustrates the pervasive impact which computers have had on American society in the short period since the first digital computer became operational in 1951:

*"In the early 1950s, almost all computers were owned by or devoted to applications of the federal government..... The computers of 1950 were not devices. They were rooms -- big rooms -- full of tubes, circuits, ventilating equipment, and people.... In the mid-1950s there were fewer than 1,000 computers in the United States - and fewer than 100,000 computer professionals.... At the end of 1976 (there were) some 220,000 computers in the U.S. (about one per every 240 families in the U.S.) Approximately 40% of these machines are medium or large computers, and 60% are minicomputers. Minicomputers are small in size and by definition cost less than \$50,000.... The number of computer professionals has increased to about 2,500,000.... By 1980 the number of minicomputers will reach about 750,000, but the number of microprocessors will exceed 10 million.... As minicomputers became a marketable product (a lot of them cost less than \$10,000), we saw the users change from large institutions to small institutions and wealthy individuals. With microprocessors, the customers are potentially everyone. In addition, it is estimated that some 30% of the computers in the U.S. are parts of computer networks.... We can surmise that the future evolution of computers and computing will be markedly influenced by this new mix of ownership, just as the initial phases of development were so strongly influenced by the federal government."*

Because of reduced costs and wider availability of computers, the process of knowledge retrieval will become increasingly decentralized in the 1980s. Minicomputers and microprocessors will permit local processing and manipulation of data retrieval from remote files, and the flow of electrons will replace the flow of paper in many businesses.

#### 2. Terminals

Terminals are the means by which users interface with communication networks, computers, remote data bases, and other colleagues with terminals. By



the mid-1980s, microprocessors will be routinely incorporated into office typewriters, copying machines, and facsimile devices as well as into virtually all data terminals and private switchboards (PABXs).

Trends indicate that by 1985 it will be possible to tie 8,000 terminals to a single processor, versus 700 in 1977.<sup>24</sup> Hard copy terminals will be quieter and faster because they will use non-impact printers. Hard copy devices are inherently more bulky and complex than soft copy (temporary) displays, however. They must store ink and paper, and their electro-mechanical components are prone to failure. There will be increasing dependence in the 1980s on video display units, which will continue to utilize cathode-ray tubes, although flat, solid-state panels will begin to replace CRTs in the 1980s. Terminals will be cheaper (in terms of 1977 dollars), but the most significant trends relate to their increasing capability, availability, and acceptance.

As terminals become more accessible, telecommunications will be used increasingly for message distribution. A pervasive system of interconnected, "smart" terminals is the prerequisite for cost-effective "electronic mail" service. Abramson observes, however, that use of this term is as misleading as the term "horseless carriage" was in describing the impact of the automobile on transportation.<sup>25</sup>

IBM argues that it will become cheaper and a great deal more convenient during the 1980s to store office materials in a remote data base than in a file cabinet.<sup>26</sup> The embodiment of this concept is known as the "paperless office." Letters will be typed using terminals that store and forward the alphanumeric characters to a remote data base from which the author may review and edit the manuscript and order its distribution to recipients in the next office or across the country. The process will bypass not only the U.S. Postal Service but also the internal mail distribution system at each end. Distribution time will decrease from days to seconds.

A key to acceptance of this procedure will be adequate privacy.<sup>27</sup> Messages will be encoded in a digital format to incorporate cryptographic safeguards and password protection. Use of fiber optics from the terminal to the concentrator/satellite earth station will provide increased privacy by means of physical isolation and also very low response times. Security will not be perfect, but it should be considerably better than that now offered by the U.S. Postal Service.

### 3. Storage

Improvements in the areas of audio/image, facsimile, microform, television, video disc, and digital recording are foreseen by Nisenoff.<sup>28</sup> For high volume users *"video discs will be the most cost effective system for large reference collections in an office,"*<sup>28</sup> whereas microform combines the features of portability and the ability to store a large volume of data. The contents of a book will become available on video discs for about 10¢ per book.<sup>30</sup> As soon as inexpensive, hand-held readers are available, this medium is likely to become very popular. Facsimile manufacturers are developing units to interface with high-speed data channels in response to encouragement from Satellite Business Systems. Existing prototype units have reduced the transmission time for a page of facsimile material from three minutes to 10-to-30 seconds, depending upon the bandwidth of the channel. Similar units are expected to be commercially available by 1981.<sup>31</sup>

Storage has been a problem for libraries for many years. It now appears that the video disc will solve this problem. The Subcommittee on Science and Technology of the National Science Foundation Task Force on Scientific Information Activities recently observed:<sup>32</sup>

*"Among the video-disc systems are two under development by the entertainment related industries. One of these, the MCA-Phillips system, seems particularly well adapted to the needs of scientific information systems. The storage medium is a plastic record similar in size to the usual long playing phonograph record. It rotates at 1800 rpm, plays for 20 minutes, and is read by a laser reading device rather than by a mechanical stylus. The amount of information that can be stored on such a disc is the equivalent of 360,000 pages of text.... Regardless of whether cost-effective and accurate optical character recognition devices are now available, it is possible and practical to store a one million volume library on a one-foot by one-foot shelf, 20 feet long, in digitally encoded form, or at worst in 200 feet of shelving -- one wall of a large room. So storage no longer presents a technical problem.*

### 4. Publishing

From 1960 to 1974 the number of journals increased 2% per year, journal articles 2.6% per year, books 10.9% per year, and dissertations 11.5% per year.<sup>33</sup> However, the cost of publishing is increasing, due primarily to paper and labor costs, and publishing revenues on a per book basis are decreasing. Publishers also are facing increases in the time lag between receipt of the author's manuscript and its eventual distribution due to the rising volume of material they are receiving.

Advances in information technology have altered the process of creating scientific and technical publications. Baker and his colleagues describe the process at Bell Laboratories where there are now an average of one minicomputer and five terminals per 15 professionals.<sup>34</sup> As an author conducts his research (often making extensive use of computers to model and analyze the problem), the report evolves with it (Fig. V-2).

*"An article can now be typed once into a computer, and updated as often as the author, the referees, and the editors require. When the article is in final form, a computer-driven phototypesetter can produce camera-ready copy that is essentially indistinguishable from the best manual typesetting.... Citations can be obtained from an on-line data base and numbered automatically. Computers can also help in locating spelling errors, making notational changes, and constructing indexes. Even page layout can be accomplished by computer, thus eliminating the need for galley proofs."*<sup>35</sup>

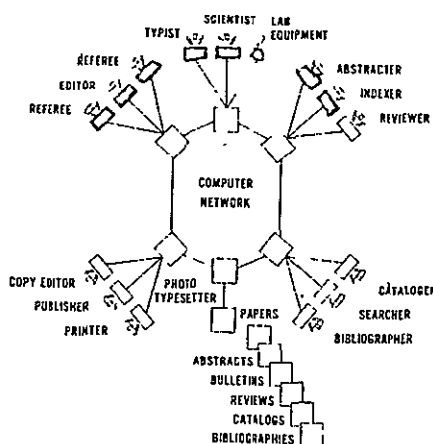


Fig. V.2. Evolving System for Scientific Communication (Ref. 34)

Publishers are approaching a critical juncture. Information technology provides a means of reducing publishing costs but in the process leads to the creation of a full-text data base, which is becoming a source of competition

to hard copy publications. Computer access to remote source materials already is cheaper and more convenient than acquisition of hard copy in the case of many of the abstracting and indexing sources.<sup>36</sup> On the other hand, inertia, uncertainties associated with interpretation of the new copyright law, and other policy issues will slow down the rate at which these changes are adopted (see Section G).

#### 5. Data Bases

The majority of the world's currently generated research literature is now accessible in the form of bibliographic references through computerized on-line search services.<sup>37</sup> The decreased cost of storage, the decreased cost and improved performance of character recognition equipment, the increase in the number of publications prepared by computerized procedures, and the corresponding increase in the percentage of publications which are captured in computer-readable form will all contribute to an increase in the utilization of full-text data bases. Use of numeric data bases also will increase in the next decade. Luedke has identified sources which cover more than 10,000 numeric data bases and systems.<sup>38</sup>

Data bases can be numerical (e.g., the census tapes), representational, alpha-numeric, or mixed. A representational data base contains pictorial or graphic information, as in the chemical structures files that the Chemical Abstracts Service provides. Alpha-numeric data bases include full text data bases, partial-text data bases, bibliographic (reference) data bases, and bibliographic-related data bases. A full-text data base is LEXIS, which contains legal statute information. It is often important to have legal information in context, justifying the cost of incorporating full text information in the data base. A partial-text data base contains portions of texts: extracts, abstracts, introductions, summaries etc. The Information Bank of the New York Times is a partial-text data base which contains shortened versions of all the articles which appear in the New York Times plus selected material from some seventy other publications in the United States. A bibliographic data base is one that contains references or citations associated with literature sources. Chemical Abstracts' CA Condensates, Engineering Index's COMPENDEX, and Bio-Sciences' BIOSIS PREVIEWS are a few examples selected from among several hundred bibliographic data bases. A bibliographic-related data base is one that does not contain bibliographic citations but does contain information which sends the user to those citations. CASIA (Chemical

Abstract Subject Index Alert), a bibliographic-related data base produced by Chemical Abstracts Service, is basically an index data base containing neither abstracts nor citations but index terms and abstract numbers (related to the bibliographic citations) which point to the abstracts.

Networks of data bases or "distributed" data bases are evolving. A distributed data base contains related files in separate locations with logical interconnections which consist of commonly held data elements. An example of the utility of distributed data bases may be found in the field of chemistry. There are in existence today some seven million unique chemical substances, but there are also some 40 to 50 different ways of identifying these substances (nomenclature, formulas, graphic representations, linear notations, connection tables, etc.), which poses a problem. One inadvertently could fail to retrieve relevant information about a compound from a data base by searching with a "wrong" (but technically acceptable) identifier. Williams and MacLaury analyzed some 161 different chemical data bases with 70 different types of identifiers for representing chemical compounds.<sup>39</sup> A correspondence (or "mapping") which relates identifiers, substances, and files was established to allow users to retrieve relevant information about a substance from all of the distributed files, regardless of which identifier was used to initiate the search.

The distributed data base concept can be extended to link not only data but also software for searching data bases and for manipulating data obtained through a search. Data can be obtained from a data base in one location and transferred to a computer in another location where a software package is available to process the information in the manner desired by the user.

Increased availability of terminals, greater sophistication in the use of computers by the general public, and increases in the number, size, and variety of data bases is certain to increase their use. A key obstacle, however, is the development of software which will make access to available data bases simple, inexpensive, and convenient. If certain on-going research is successful, systems which perform fact retrieval and knowledge retrieval -- not simply reference retrieval and data retrieval -- will be implemented in the 1980s. Further discussion of this research appears in Section E.

## 6. Software

The term "software" has been coined to include all of the programs needed to operate the computer, to perform a given application, and to allow individuals to communicate with the computer. Software is by far the largest cost element of computerized information systems. Davis described the current status of "software engineering" in the March, 1977 issue of Science:<sup>40</sup>

*"Listeners always evince genuine surprise when they are told that, today in 1977, there is no theoretical (or mathematically rigorous) way to prove programs correct (except for trivial programs containing less than 100 statements).... As a result, software is the most unsafe, the least understood, and the most expensive component of total computer system costs. Software development costs are now almost 90% of total computer system costs. This percentage will probably increase along with the absolute costs of software, since software design, development, and testing is the most highly labor-intensive component of computer system products. The really useful and exciting advances in computing will probably only proceed at the same pace as advances in software engineering. And this will be distressingly slow."*

Software improvements in the information field will lie in the area of making systems more user oriented. To gain widespread acceptance, it must be possible for the average individual to use the retrieval system directly without having to go through an intermediary. Although the transition from machine languages to assembly languages to high level languages has reduced the amount of training required to write or use computer programs, most people are intimidated by computers. There is a need to develop languages which approach natural language. The computer must be taught to speak the user's language.<sup>41</sup> The work required to improve the interfaces between the user and the computerized information system will be time consuming and expensive.

### E. User Oriented Knowledge Retrieval

The goal of knowledge retrieval is to approximate as closely as possible the ease with which one could obtain facts and knowledge from a hypothetical person who was at once objective, easy to relate to, current in his knowledge of the subject of interest, and in possession of a photographic memory. Licklider, in a classic 1964 study of the implications of computer technology to library functions in the year 2000, states:<sup>42</sup>

*"The aim is to get the user of the fund of knowledge into something more nearly like an executive's or commander's position. He will still read and think and, hopefully, have insights and make discoveries; but he will not have to do all of the searching himself nor all the transforming, nor all the testing for matching or compatibility that is involved in creative use of knowledge. He will say what operations he wants performed upon what parts of the body of knowledge, he will see whether the result makes sense, and then he will decide what to have done next."*

Licklider described 25 criteria that would make a knowledge retrieval system truly user oriented.<sup>43</sup> Four of these criteria were that the system should:

1. Be available when and where needed;
2. Make available a body of knowledge that is organized both broadly and deeply;
3. Adjust itself to the level of sophistication of the individual user, providing terse, streamlined modes for experienced users working in their areas of expertise, and functioning as a teaching machine to guide and improve the efforts of the neophyte; and
4. Essentially eliminate the publication lag.

An example of a knowledge retrieval system for the home market would be a system capable of accessing the cookbooks of the world, with sufficient flexibility that one could factor in one's preferences regarding seasoning, preparation time, calories, etc. A more complex system would enable the user to select recipes for each course of a complete dinner menu. It then would estimate the total preparation time and upon command would provide step-by-step directions to coordinate preparation of the complete dinner so that all of the courses were ready to serve at approximately the same time.

Computers are still limited in their ability to simulate intellectual tasks, however. Referring to Fig. V-1, the nonclerical aspects of information retrieval still must be performed by human beings. But mere substitution of the flow of electrons for the flow of paper to perform clerical tasks (i.e. use of a data base rather than a file cabinet) would result in large productivity gains in several areas of the economy (see Chapter VII). During the 1980s progress in information retrieval probably will occur on two broad fronts:

1. There will be increased acceptance of proven retrieval techniques. The technology is now adequate to meet the clerical needs of the paperless office; and
2. Advances in information technology will extend the state-of-the-art beyond simple reference retrieval to data, facts, and -- ultimately -- knowledge.

To improve the power and acceptance of information-retrieval services, the interfaces between the user and the computer must be improved. The user must feel he is the master, rather than the slave, of the machine. A wide variety of information-retrieval services are available today, but they are not widely utilized. The data bases vary with respect to subject coverage, source type (journals, monographs, patents, theses, book reviews, etc.), file format, data elements included, and indexing or vocabulary practices. The retrieval systems vary with respect to command languages, protocols, and system responses. Only the persistent user who is prepared to learn the language of each system very precisely is likely to be satisfied with today's systems.

What can be done to solve the problem? One alternative is to implement standards for all components of information systems, an impractical goal due to the time required to develop standards and the lack of enforcement mechanisms. A more promising alternative is to develop user-oriented, transparent systems -- systems which contain the necessary translators to circumvent the need for the user to understand all of the specific differences between data bases and between all search systems.<sup>44,45</sup> From the user's point of view, these translators would make all systems appear to be alike and would make all data bases appear to use his vocabulary.

Research is being conducted in a number of areas to make information systems more user oriented. Examples include:

- . MIT's work on a common command language<sup>46-48</sup>
- . EURONET's investigation of common command language<sup>49</sup>
- . Work at the University of Illinois on an automatic data base selector<sup>50</sup>
- . Battelle's work on automatic vocabulary switching<sup>51</sup>
- . EURONET's investigation of multilingual data bases<sup>52,53</sup>
- . Work at the University of Illinois on data base mapping for distributed data bases<sup>54</sup>
- . National Bureau of Standards work on access protocols<sup>55,56</sup>
- . National Library of Medicine work on "cordial" interfaces for various classes of users<sup>57,58</sup>



It is possible that natural language software and transparent information retrieval systems will be developed in the 1980s. Unforeseen, but profound alternations of the human condition probably will follow.<sup>59,60</sup> Ruth Davis attempted to explain the curious mixture of admiration and concern with which people view the evolution of artificial intelligence:<sup>61</sup>

*"Until the age of computers, inventions had primarily extended our muscular powers as well as certain of our sensory powers. The Industrial Revolution always comes to mind as the epitome of those inventions which replaced or extended man's muscular power. Telephones and microscopes are excellent examples of extensions of our vocal and visual powers. But throughout all history man was never threatened by anything -- animate or inanimate -- that could equal, extend, or surpass his intellectual capabilities, until the computer."*

## F. The Cast of Characters

### 1. National Commission on Libraries and Information Science (NCLIS)

From its beginning, NCLIS has promoted the idea of equal access to information for all citizens and the rapid integration of new technological methods and devices with the mainstream of information activities. Application of new forms of telecommunications, including satellites, is part of its national network concept.

NCLIS was created by PL 91-345 (July 1970) as an independent agency in the executive branch; actual establishment of the Commission occurred in 1972. Its functions include advising the President and the Congress on matters relating to library and information policy, conducting needed studies and surveys, evaluating effectiveness of existing programs, developing plans for meeting national needs, and promoting research and development.

NCLIS has a small, permanent staff and minimal financial resources to support necessary studies. It operates primarily by encouraging and coordinating activities that will lead to improvements in communications among libraries and information centers and between these centers and their users.

### 2. National Library of Medicine

The only major national library leadership in applying telecommunications delivery methods is based at the National Library of Medicine. The Lister Hill National Center for Biomedical Communication (LHNCBC) was established by Congress in 1968 to reduce the delay between discovery and application of useful knowledge. LHNCBC is a part of the National Library of Medicine.

In 1963 the National Library of Medicine began work that led to the development of the MEDLARS computerized bibliographic system which quickly became the basis from which INDEX MEDICUS is printed. There are now 28 library publications which are generated by the MEDLARS files which contain citations from over 3,000 medical journals. In 1971 this bibliographic service went on-line and today provides service to over 400 institutions in the U.S., Canada, Great Britain, France, and Australia, and to the World Health Organization in Geneva.<sup>62</sup> Sweden and Brazil use tapes which are provided by the National Library of Medicine, which presently makes available ten different data bases to users. In 1975 there were 402,058 on-line searches, 280,000 MEDLINE, and 122,058 TOXLINE/CATLINE searches.<sup>63</sup> Two hundred and twenty-eight thousand inter-library loans were made by the reference service of the National Library of Medicine in 1975, and there are now an estimated 1,500,000 items in its files.<sup>64</sup>

Experiments with all modes of communication technology began in 1970 and have continued without interruption since. Of special interest are the experiments which were conducted on NASA's ATS-1, ATS-3 and ATS-6 satellites in support of health care in Alaska, teacher education in Appalachia, and improved teaching methods in medicine (the WAMI experiment).

### 3. The Library of Congress

The Library of Congress early recognized that the widespread application of computer technology to libraries could come about only if bibliographic data in machine-readable form could be distributed with precision and at reasonable cost. After considerable study and a great deal of cooperative effort with other libraries, the MARC system (Machine Readable Cataloging) was developed and put into use in 1968. This distribution of bibliographic data in machine-readable form facilitated development of automation throughout the library community.

Following the development of the MARC system, the Library of Congress committed itself to take a leadership role in coordination with other network-related organizations in the design and development of the library component of the national library and information services network, as developed and proposed by the National Commission on Libraries and Information Science (NCLIS).<sup>65-67</sup>

Early in 1977 it established the Network Development Office to meet

*"its responsibilities in regard to library bibliographic services and to coordinate the planning activities leading toward the development of the library bibliographic component of the National Library and Information Service Network, in cooperation with other network-related organizations."*<sup>68</sup> The Network Development Office has established a group of senior representatives of network-related organizations and funding agencies called the Network Advisory Group. The NAG has recently published a major position paper, "Toward a National Library and Information Service Network: the Library Bibliographic Component." The Network Advisory Group also formed, early in 1977, the Network Technical Architecture Group (NTAG) which has taken as its initial task the development of links between the computer at the Library of Congress and the computers of the majority of the NTAG participants. These participants will be able to access files containing bibliographic, authority, and location information. Their second task will be to make these links compatible with standard national and international protocols, while their third project will extend the network to provide standardized bidirectional links between the bibliographic utilities, providing a powerful tool for resource sharing.

Another aspect of Library of Congress involvement in telecommunications is found in the Division for the Blind and Physically Handicapped (DBPH). The division distributes Braille and recorded books, music, and equipment through a national network serving more than a half-million readers. Regional and multi-state centers are connected via telecopier/facsimile equipment and computer; these centers also produce original materials for local use. DBPH estimates that as many as 7.6 million persons may be eligible for its services.

DBPH has supported the development of many technological advances -- an automatic reverse cassette machine, a music typewriter that converts scores to punched cards, and a Braille print train that interfaces with the MARC system to provide Braille printouts. The use of ancillary signals for television (e.g., captioning) is also of interest to DBPH.

#### 4. American Library Association (ALA)

ALA is the largest professional organization for libraries, having approximately 35,000 members. It is organized into a number of library types (e.g., academic library, public library) and functional divisions (e.g., reference, adult services) and sponsors meetings and round tables on a diverse range of

topics. The Association is a member of the Public Service Satellite Consortium; its executive director, Mr. Robert Wedgeworth, serves on PSSC's Board of Directors.

Within ALA, the Information Services and Automation Division (ISAD) has principal responsibility for monitoring developments in networking and telecommunications. Its members often represent ALA on matters of technical standards and telecommunications policy. ISAD has three sections, the Video, Cable, and Communications Section, the Audio-Visual Section, and the Information Science and Automation Section. To date, neither ALA nor ISAD has been actively involved in a leadership role to promote national programs in networking and information retrieval. ALA is currently interested, however, in developing plans for a demonstration project involving library applications of telecommunications and computer technology.

#### 5. Commercial Activity

The growing commercial interest in the library market for automated services is discussed by Martin.<sup>69</sup> Competition among industry participants is keen and consensus on philosophy is not always possible. Many of the commercial interests are members of the Information Industry Association, which has been an active participant at hearings and professional meetings within the library community. NCLIS has been careful to recognize and protect commercial interests in developing a plan for a national library and information services network.<sup>70</sup>

#### 6. State Library Agencies

There is some evidence that increasing responsibility and leadership will be found at the state level. In the NCLIS plan, state governments would incur the major share of the cost of intrastate operations while state and federal library agencies would jointly plan and finance interstate services.<sup>71</sup> A recent report to the Urban Libraries Council recommended that the states assume greater responsibility in developing and financing public library and information services.<sup>72</sup> The report argues that public library development should be considered an integral part of the states' mandate to provide public educational services and that funding patterns for public schools and public libraries should be brought into closer balance. Local governments now contribute 82% of the support for public libraries, while the state and federal government contribute 13% and 5%, respectively. By contrast, financial support for public

elementary and secondary schools is distributed among local, state, and federal funding sources as follows: 50% from local funds; 42% from state funds; and 8% from federal funds.<sup>73</sup>

7. The Community Library (Telecommunications Center?)

There is disagreement within the library community regarding the appropriate role of the community library. Publicly supported libraries, including state libraries and some academic libraries (especially those at community and junior colleges), are re-examining their philosophies with respect to users served, services rendered, and funding mechanisms. Libraries that eventually will assume greater responsibility for adult education and other community-service activities may elect to exploit fully options to improve access to information services, thereby strengthening community support in the 1980s.

The community library could become a "retail outlet" for many externally provided information services in the 1980s and also could provide a data base to support local community affairs (e.g., a calendar of events for special groups such as the handicapped, the aged, the Little Leaguers, etc.). The library, serving as the community telecommunications center, could become a local outlet for regionally produced programs to train the library staff and to provide adult education to the community. The burgeoning field of adult education is discussed in Chapter VI, and a promising system example -- which could be built around the community library -- is described in Section D of Chapter VII. "Distributed" conferences, in which national meetings of organizations such as the National Education Association or the Democratic Party were designed to include local participation around the country, could become popular if the local outlet were equipped to permit interaction with the national headquarters. The community library could become the setting for video teleconferences, which could be used for legislative hearings or meetings of a national or regional organization having a decentralized staff.<sup>74</sup> It might also serve as the temporary repository (or "electronic file cabinet") of materials which were later retrieved by local schools, hospitals, newspapers, banks, commodity dealers, etc. Finally, the community library exists to facilitate knowledge retrieval. The full range of information-retrieval services which are described in this chapter could be made more widely available if the community library were willing and able to promote increased use of these emerging services locally.

Proponents of increased library services inevitably become entangled in a controversy among librarians regarding the propriety of fees for service. Opponents of this concept cite restrictions in access (the poor may be excluded), improper competition with the private sector (many commercial suppliers feel that competition from a subsidized entity such as the public library would be unfair), or "double taxation" (in the tax bill and at the library).<sup>75</sup> Proponents argue for improved service to the community, increased library productivity, and a reduced drain on the public treasury.<sup>76</sup> Proponents assert that both private suppliers and the public library will come out ahead if a greater range of information services is offered to the general public through the library/telecommunications center.

It is ironic that of all the elements of the library community, the local community library, which could most benefit from improved telecommunications service, is least informed about developments in this area. Demonstrations of the efficacy of emerging information services, which could significantly broaden public support for the community library, would foster needed understanding among local librarians. A careful needs assessment of a cross-section of community libraries, which encompassed both the basic staff/patron interactions which occur as well as the more mundane "technical service" (back office) operations, would facilitate development of appropriate new information services for a community-library setting.

#### G. Impediments to Progress

The development of computer and communications technology brings genuine promise of integrated access to a network of networks which will tie together most of the world's current literature and data. There are, however, a number of non-technical barriers to be overcome.

The lines between the computer industry, which has never been regulated, and the communications industry are becoming increasingly blurred as communicators go to a digital format and computer users make increasing use of a communications channel. Neither the computer nor the communications satellite had been invented when the basic Communications Act was enacted into law in 1934. The Congress has undertaken the monumental task of revising the Communications Act to bring a greater variety of services, increased technological innovation, and lower prices

to the consumer -- without undermining the vitality of the communications industry. Domestic telecommunications policy in the 1980s will depend upon the outcome of current deliberations to revise the Communications Act, the decisions of the FCC regarding the boundaries between regulated and unregulated activities in the computer and communications industry, and two antitrust suits which are now in litigation involving the U.S. Department of Justice, IBM, and AT&T.

Branscomb has outlined a set of principles to guide formation of U.S. telecommunications policy. These include:<sup>77</sup>

- . Equitable access to the system
- . Non-discriminatory rates
- . Privacy for private applications
- . Right to correct inaccurate messages circulated by third party
- . Shared use to aggregate resources and reduce costs
- . Freedom of choice for receipt of information
- . Right to prohibit third parties from distributing proprietary information without permission or appropriate compensation of that source.

PSSC would add that national R&D priorities should place increased emphasis on systems analysis to drive down the total end-to-end cost of information services.<sup>78</sup> What are the tradeoffs among the cost elements of the communications and computer apparatus? What are the tradeoffs between system performance and user acceptance of the service? In those elements of the process which must be regulated, what is the relationship between cost and price? What should this relationship be?

Other non-technical factors which will bear upon the rate of acceptance of knowledge retrieval services are: interpretations of the copyright law;<sup>79</sup> decisions of the Internal Revenue Service regarding eligibility for deducting the cost of maintaining an office at home; decisions of the Congress and the courts regarding an individual's right to privacy<sup>80</sup> (what data ought to be recorded, how long should it be kept, what release procedures should be used, should individuals be allowed to examine their full record); decisions by the U.S. Postal Service regarding the extent and cost of electronic transmission of messages; decisions by the FCC and the International Telecommunications Union regarding priorities for using orbit-spectrum space; and import/export restrictions regarding trade in "hard" and "soft" information sources.

To the commercial supplier of information systems, libraries, like health

and education, represent a disaggregated market (see Chapter II). There is a need for improved coordination among the elements of the library community before regional or national information systems can be planned and implemented. A deterrent to progress has been the librarian's tendency to cluster these elements according to "type" (e.g., academic, special, or public library), thereby artificially creating distinctions between institutions which actually have much in common. A better way for library education units or professional societies to cluster the various elements would be to avoid institutional distinctions and to concentrate on the functions of people who work in libraries. Information retrieval specialists would belong in one group, personnel officers in another, etc. Two states, Colorado and Indiana, have developed multi-unit public library systems to actively promote institutional sharing. Libraries in private settings are encouraged to obtain services by contract with these public library systems, thereby broadening access, facilitating resource sharing, and enhancing professional development.

As mentioned previously, libraries lack baseline data regarding the mission, procedures, and cost for all but the so-called "technical services" (such as cataloging and acquisitions) that do not involve direct contact with the consumer. It is difficult if not impossible for most libraries to compare objectively the cost and benefits of computerized knowledge-retrieval services with traditional procedures. There is a need for a systemwide needs assessment, particularly of community libraries. Demonstrations of the efficacy of information networks to promote understanding and increase acceptance would foster adoption of information technology.

Cooperation will be needed among all of the parties that are affected, both in the private and public sectors in the U.S. and internationally. Interested parties include the publishers of primary and secondary information, data base producers, libraries, information analysis centers and other repositories, information processing centers and brokers of information services, computer centers, equipment manufacturers, common carriers, federal and state policymakers, and the user community -- researchers and the general public.

#### H. Projected Telecommunication Requirements

PSSC does not as yet have sufficient information regarding the requirements of a national knowledge-retrieval network to accurately project potential traffic.



Progress in this direction has been made by NCLIS;<sup>81</sup> but a great deal of additional work must be done to understand the applications which are most likely to gain broad acceptance, the required grade of service, the number of libraries which are likely to participate, the number of different applications, the frequency of use of the different applications, the required number of terminals per site to support the applications, the required scheduling, and -- ultimately -- the probable demand for each service as a function of the end-to-end price of that service. Nonetheless, a preliminary indication of the potential traffic requirements may be extrapolated from the present cataloging service of the Ohio College Library Center (OCLC).

At the present time, OCLC serves approximately 850 libraries in 44 states and has a monthly telephone bill of \$190,000, which comes to \$2,280,000 per year.<sup>82</sup> The participating libraries are estimated to spend about 3% of their operating budgets on automated services, a figure which may rise to at most 8% to 15% of their operating budgets by 1982.<sup>83</sup> Thus, the communications market for existing and planned OCLC services is projected to amount to between \$6,000,000 and \$11,400,000 within the market already served. Allowing for possible growth in OCLC's membership (only 850 of 26,733 U.S. libraries are now customers), the projected revenue could rise further by a factor of two to three, recognizing that OCLC probably serves many of the largest potential subscribers already.

What does OCLC's present cataloging service represent in terms of required communication capacity? Last year, 5,707,828 books were cataloged over the OCLC system. Each bibliographic record contains an average of 4,800 bits, or the volume of catalog traffic in 1975-76 was approximately  $2.7 \times 10^{10}$  bits per year.<sup>84</sup> Allowing for the same relative growth in traffic as was assumed for revenue, by the year 1982 this service might require at most something on the order of  $10^{12}$  bits per year of capacity. To place this figure in perspective, a single Satellite Business Systems (SBS) transponder continuously operating at 50 megabits could relay approximately  $1.6 \times 10^{15}$  bits of data per year.

To gain a qualitative understanding of the level of demand for remote-access information retrieval in 1982, assume that 1% of the present population will search a remote data base an average of once a week at a cost of \$2 per search in 1982. Assume that 10% of this revenue is available to the common carrier.

Then this service would produce \$22.9 million of revenue to the carrier. Assuming that each search requires an average of 48,000 bits to encode (which is typical of Lockheed's DIALOG system),<sup>85</sup> the required satellite capacity would amount to  $55 \times 10^{12}$  bits per year, which would correspond to roughly 0.3% of the peak capacity of an SBS transponder, if the loading were uniform.

In conclusion, using established administrative and technical procedures, libraries could account for between \$6 million and \$30 million of traffic on a satellite in 1982. If economical and efficient remote-access information retrieval is available by 1982, this service easily could provide an additional \$20 million of revenue.

The total required communications capacity is modest. Application of packet broadcasting techniques, using low-cost, two-way earth stations, probably will result in a substantial cost savings to the library community. Wideband service may be necessary, however, to provide acceptably low response times. Further discussion of this subject may be found in Chapter VII.

#### I. Conclusion

In time, the flow of paper will be replaced by the flow of electrons as we place increasing reliance on communication and less on transportation. The possibilities inherent in using digital computers to support knowledge retrieval have been known for over 15 years. Developmental efforts have been slowed by the fact that computers were too slow, too expensive, had too little memory, and were too little appreciated by the general public. Each of these barriers is gradually being overcome, and by 1985 there probably will be widespread acceptance of the "paperless office" and increasing interest in actual knowledge retrieval, rather than present-day source-retrieval.

The problems of developing natural-language software and user oriented (transparent) retrieval systems are under intense study (see Section E). Progress undoubtedly will occur on both fronts in the 1980s, resulting in information retrieval systems which are more powerful, easier to use, and less expensive.

Licklider correctly sensed in 1964 the complex of factors which would dictate the pace of development of knowledge retrieval services:<sup>86</sup>

"Very great and pertinent advances doubtless can be made during the remainder of this century, both in information technology and in the way man uses it. Whether very great and pertinent advances will be made, however, depends strongly on how societies and nations set their goals. Moreover, the "system" of man's development and use of knowledge is regenerative. If a strong effort is made to improve that system, then the early results will facilitate subsequent phases of the effort, and so on, progressively, in an exponential crescendo. On the other hand, if intellectual processes and their technological bases are neglected, then goals that could have been achieved will remain remote, and proponents of their achievement will find it difficult to disprove charges of irresponsibility and autism."

## CHAPTER V

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## CHAPTER VI

### CONTINUING EDUCATION

#### A. Introduction

The concept of continuing education is elusive. It has been defined globally as "life-long learning," more narrowly as "adult education," and still more specifically as "continuing professional education." Continuing education in its broadest sense responds to a wide variety of needs -- basic adult education, inservice training, preparation for license examinations, recertification, and upgrading of competencies and skills.

The Aspen Program on Communications and Society in its report "The Cable and Continuing Education" states:<sup>1</sup>

*"Because continuing education programs are sponsored by so many institutions and take place in such a variety of forms -- night and weekend classes, correspondence, independent study, on-the-job training -- it has been difficult to measure their total scope. But it is clear that the numbers are large. Estimates of the number of adults engaged in organized study vary from a figure of 32.1 million to perhaps more than 100 million."*

Others estimate that about 2 million adults over thirty are enrolled in some type of post-secondary school program in the U.S.<sup>2</sup>

Continuing education occurs in many institutional settings -- community colleges, four-year institutions of higher learning, hospitals, medical specialty societies, military bases, correctional institutions, community libraries, as well as "open universities" and "universities without walls." Now that the population is growing older and the number of undergraduate applications to colleges and universities is declining, it represents the largest growth area of higher education.

The rising demand for continuing education has been documented by numerous studies; it is reflected in the increasing number of states which require continuing education for certain professions, the number of medical specialty societies which sponsor continuing education courses, the growth in the number of continuing education courses being offered, and perhaps most pervasively in society's growing awareness of the information explosion and the obsolescence of knowledge.

## B. Trends in Continuing Education

Whereas teachers were once the mainstay of the continuing education market, they no longer can be depended upon to provide the backbone of support for the entire system due to substantial changes in employment patterns, the internal policies of school districts, and the general economy. Many districts are now imposing restrictions on the kind, quality, and number of units which they will accept toward salary increments and promotions, and are sponsoring internal staff development programs.

A variety of other professional groups, however, have more than made up for the slack. The "Chronicle of Higher Education" reports that *"Continuing education for professionals, a minor part of the programs of college and university extension divisions a few years ago, is dominating their curricula today"*.<sup>3</sup> At least half of the licensed professions are required by state law to participate in continuing education, as may be seen in Figure VI.1.<sup>4</sup> Evidence of growth in continuing education is reflected in the following:<sup>5</sup>

- .. Continuing education is required by various states for eleven professions.
- .. Seventeen states require continuing education for physicians; an additional eleven states have approved but not yet implemented similar requirements.
- .. Eight states have mandatory requirements for dentists and another twenty-seven are considering it.
- .. Nine states have requirements for nurses, although the programs in three states are not yet operating.
- .. Fourteen states require continuing education for pharmacists.
- .. Thirty-eight states require continuing education for nursing-home administrators.
- .. Forty-five states have mandatory requirements for optometrists.
- .. Eighteen states require continuing education for veterinarians.
- .. Four states have mandatory continuing education for lawyers, and an additional three have requirements for legal specialization. Legislative action is pending in nine states and under study in another eleven.
- .. Eleven states require further education for a person to be re-licensed as a realtor, while an additional twenty-six are considering it.
- .. Six of the nineteen states that regulate social work have mandated continuing education for social workers.
- .. Twenty-three states have passed legislation governing certified public accountants.

Figure VI.1

STATES THAT REQUIRE PROFESSIONALS  
TO CONTINUE THEIR EDUCATION

	Certified Public Acct.	Dentists	Lawyers	Nurses	Nursing Home Admin.	Optome- trists	Pharma- cists	Physicians	Real Estate Personnel	Social Workers	Veteri- narians
Alabama	x				x	x	x	*			x
Alaska	x					x		x			x
Arkansas					x	x					x
Arizona					x			x	x		
California	x	x	x	x	x	x	x	x	x		
Colorado	x			*	x	x		x	x	x	x
Connecticut					x	x					
Delaware						x				x	
Florida	x		x	x	x	x	x	*			x
Georgia					x	x					
Hawaii	x				x	x					
Idaho						x			x		
Illinois						x		x			x
Indiana					x	x	x				
Iowa	x		x		x	x					
Kansas	x	x		x	x	x	x	x		x	x
Kentucky		x			x	x	x	x	x	x	x
Louisiana					x	x			x		
Maine					x	x	x	*			
Maryland	x				x	x		x		x	
Massachusetts					x	x		*			
Michigan	x					x		x			
Minnesota	x	x	x	x	x	x	x	x	x		
Mississippi					x	x					x
Missouri						x					
Montana					x	x		*			x
Nebraska	x			x	x	x		x	x		x
Nevada	x				x	x	x				x
New Hampshire				x	x	x					
New Jersey					x	x	x	*			
New Mexico	x	x			x	x		x			
New York								*			
North Carolina					x	x		*			x
North Dakota	x	x			x	x					x
Ohio	x				x	x	x	x			x
Oklahoma		x			x	x	x				
Oregon	x			*	x	x	x	*	x		
Pennsylvania	x							*			x
Rhode Island						x		x			
South Carolina	x					x					
South Dakota	x	x		*	x	x				x	
Tennessee						x					x
Texas			x		x	x			x		
Utah								x			
Vermont	x				x			*			
Virginia						x					
Washington	x		x		x	x	x	x	x		x
West Virginia					x	x					
Wisconsin			x		x	x		x			
Wyoming	x				x	x					

\*indicates statutes that have not yet been put into effect

- .. Some professional associations are now requiring continuing education for membership. They include sixteen state medical societies, eight state dental societies, and two societies for certified public accountants.

In addition, there exists an emerging group of paraprofessionals who never before have been licensed but who now are seeking to establish standards of quality for their professions via certification and licensing programs.

The foregoing is evidence that the public expects increased accountability from all providers of goods and services. The fear of more stringent federal and state regulations has led many professional groups to encourage voluntary participation in continuing education courses. The focal point of this movement has been the professional societies because of the regional nature of their membership and because of their mandate to maintain quality through development of educational activities for the membership.

The value (and necessity) of continuing professional education is rarely questioned; the threat of professional obsolescence is widely recognized. The lifelong obligation to seek new knowledge is acknowledged in professional codes of ethics, as evidenced by a comparative study of architecture, business administration, law, medicine, nursing, engineering, psychology, social work, teacher education, and veterinary medicine.<sup>6</sup>

The challenge of meeting the variety of needs of a heterogeneous population is obvious. It is impossible to over-emphasize the diversity of demand for continuing education course offerings. One of the nation's leading "non-campus universities," the University of California Extension, reflects this diversity. In 1972-73, the enrollment by field of study was as follows:<sup>7</sup>

FIGURE VI.2: ENROLLMENT IN CONTINUING EDUCATION AT UNIVERSITY OF CALIFORNIA EXTENSION

<u>Field of Study</u>	<u>Enrollment</u>
Education	71,604
Social Sciences	66,871
Humanities	48,946
Law	36,172
Health Professions	35,327
Business	33,057
Engineering	10,917
Biological Sciences	10,237
Other	<u>19,327</u>
Total:	332,458

By 1975-76, the number of registrants in the University of California Extension had grown to 389,585 -- an increase of 5.6% per year -- and 12,722 programs were offered, over half of which were professional programs.

### C. View Through a Keyhole: The Need in Health Professions

Although the demand for continuing education is enormous, the scope of the field defies precise quantification. To gain deeper understanding of the implicit requirements, this study will focus on requirements in the health professions, particularly among physicians.

Current estimates indicate that over 4.6 million people are employed in more than 200 separate professions in the U.S. health industry. Manpower requirements have grown in line with the enormous increase in the size of the health-services sector since 1960 (Section III.E). The number of persons employed in health occupations has increased 97% from 1960 to 1975; while the population has increased by 18%.<sup>8</sup> In 1975, there were 354,000 physicians in the U.S.; 935,000 registered nurses; 370,000 practical nurses; 119,000 pharmacists; 397,000 health technologists and technicians, and 192,000 dietitians and therapists.<sup>9</sup>

The major growth in continuing education for health professionals has occurred during the last twelve years. The number of AMA-accredited allied medical education programs has grown from a total of 109 in 1936 to 2,742 in 1976.<sup>10</sup> Figure VI.3 illustrates the number of allied medical education programs by occupation from 1967 to 1976.<sup>11</sup> A slight decline in programs in 1974 is attributable to a tendency of several hospital-based programs to affiliate with an educational institution.<sup>12</sup>

The establishment of the Regional Medical Program, which emphasized services for patients with heart disease, cancer, stroke, and related illnesses, has contributed significantly to this growth. The focal point of this program is technology transfer, specifically the transfer of biomedical information from leading research institutes to the practicing health professional.

A related issue has been the out-migration of health professionals from rural areas. Rural states have a significantly lower number of physicians as evidenced by the distribution of physicians by state, as shown in Figure VI.4.<sup>13</sup>

Figure VI.3 Number of AMA-Accredited  
ALLIED MEDICAL EDUCATIONAL PROGRAMS  
by Occupation, 1967-1976

Occupation	Reporting Year									
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Assistant to the Primary Care Physician	0	0	0	0	0	22	32	43	49	52
Laboratory Assistant	0	0	187	210	212	194	182	181	167	153
Cytotechnologist	98	109	118	118	117	112	108	104	103	102
Electroencephalographic Technician	0	0	0	0	0	0	0	0	0	1
Electroencephalographic Technologist	0	0	0	0	0	0	0	0	3	8
Histologic Technician	0	0	0	0	0	12	17	25	27	27
Medical Assistant	0	0	0	6	12	44	52	73	94	99
Medical Assistant in Pediatrics	0	0	0	0	0	0	0	1	2	2
Medical Laboratory Technician	0	0	0	0	0	1	5	14	24	38
Medical Record Administrator	28	27	27	26	25	30	30	33	35	38
Medical Record Technician	12	16	20	18	29	39	36	40	52	58
Medical Technologist	786	787	787	791	773	749	737	715	709	696
Nuclear Medicine Technologist	0	0	0	1	17	35	47	64	65	90
Occupational Therapist	32	32	32	36	36	38	40	41	43	43
Operating Room Technician	0	0	0	0	0	0	0	2	2	18
Ophthalmic Medical Assistant	0	0	0	0	0	0	0	0	0	0
Physical Therapist	43	48	49	52	50	60	64	66	68	72
Radiation Therapy Technologist	0	0	0	8	16	31	39	39	45	63
Radiologic Technologist	1047	1126	1152	1177	1146	1113	1109	1010	1022	915
Respiratory Therapist	30	44	55	56	82	125	132	126	140	147
Respiratory Therapy Technician	0	0	0	0	0	0	1	5	20	55
Specialist in Blood Bank Technology	0	0	0	0	0	53	53	59	61	62
Surgeon's Assistant	0	0	0	0	0	0	0	0	1	2
Urologic Physician's Assistant	0	0	0	0	0	0	1	1	1	1
TOTAL	2076	2189	2427	2499	2515	2658	2685	2642	2734	2742

BY STATE  
1973

<u>State</u>	<u>Total Active Physicians</u>	<u>State</u>	<u>Total Active Physicians</u>
New York	43,763	Oklahoma	2,929
California	42,333	Kansas	2,881
Pennsylvania	18,675	Puerto Rico	2,819
Illinois	16,950	Mississippi	2,143
Texas	15,829	Outlying Areas	2,134
Ohio	14,725	West Virginia	1,977
Massachusetts	12,931	Arkansas	1,973
Michigan	11,928	Nebraska	1,915
Florida	11,828	Utah	1,745
New Jersey	11,469	Rhode Island	1,686
Maryland	9,965	New Mexico	1,436
Virginia	7,067	Hawaii	1,317
Missouri	6,633	Maine	1,244
North Carolina	6,455	New Hampshire	1,131
Minnesota	6,301	Vermont	861
Connecticut	6,244	Delaware	813
Georgia	6,000	Montana	801
Wisconsin	5,815	Idaho	762
Washington	5,641	North Dakota	658
Indiana	5,597	Nevada	642
Tennessee	5,361	South Dakota	595
Louisiana	4,833	Alaska	399
Colorado	4,583	Wyoming	372
D.C.	3,980	TOTAL	338,111
Kentucky	3,781		
Alabama	3,457		
Oregon	3,428		
Arizona	3,380		
Iowa	2,995		
South Carolina	2,931		



Implementation of the Regional Medical Program created an awareness of the lack of necessary support mechanisms in rural areas to maintain an adequate health care system. Physicians in isolated rural areas generally do not have access to information necessary to maintain professional competence. Similarly, although allied health education programs are in every state in the U.S. as seen in Figure VI.5<sup>14</sup>, almost half of the programs are in six densely populated states: California, Pennsylvania, Illinois, Ohio, New York, and Texas.

More recently, external pressures have intensified the demand for continuing education from allied health professionals. Issues such as recertification, relicensure, cost containment, accountability, medical malpractice suits, medical audits and review boards, Professional Standards Review Organizations, and the impact of Medicare/Medicaid have stimulated interest in continuing education.

#### D. Present Status

Numerous organizational mechanisms have evolved in an effort to coordinate continuing medical education activities, including accreditation, evaluation, and review functions. The Coordinating Council on Medical Education was established in 1972 and is comprised of representatives from the American Medical Association, the American Board of Medical Specialties, the American Hospital Association, the Association of American Medical Colleges, and the Council of Medical Specialty Societies.

The Liaison Committee on Graduate Medical Education, established in 1975, is the accrediting body for graduate medical education. Its counterpart, the Liaison Committee on Medical Education, established in 1942, is the accrediting body for undergraduate medical education. In addition, the Liaison Committee on Continuing Medical Education has recently been established to accredit continuing medical education. The Joint Council on Accreditation of Allied Health Education is in the final organizational stage.

All fifty state medical associations have been approved by the Council on Medical Education to survey, review, and evaluate organizations and institutes which sponsor intra-state continuing medical education. In addition, there are twenty-four organizations which sponsor self-assessment programs.

FIGURE VI.5. DISTRIBUTION OF AMA-ACCREDITED ALLIED HEALTH EDUCATION PROGRAMS BY STATE, 1976

[illegible]

NOT REPRODUCIBLE

The American Medical Association is the largest organization with an active interest in continuing medical education. The AMA estimates that in 1974-75, 270,459 physicians in the U.S. registered for one or more programs of continuing medical education. The AMA has established a mechanism through which participation in continuing medical education can be documented -- the Physician's Recognition Award (PRA). It is awarded to physicians who complete 150 hours or more of continuing education within a three-year period. Some 58,635 physicians had up-to-date PRAs as of June 30, 1976 and 99,200 physicians have qualified for the award since the program was initiated eight years ago.<sup>15</sup>

The AMA's "Fact Sheet on Continuing Medical Education," January 1, 1977<sup>16</sup> reveals that sixteen state medical associations and seven medical specialty societies have made policy decisions which require continuing medical education as a condition of membership; all twenty-two medical specialty boards have adopted policies to require recertification; and fourteen of the twenty-two medical specialty boards have established dates when recertification will begin. The American Board of Family Practice currently requires an examination every five years to maintain certification. Seventeen states have Medical Practice Acts that require evidence of continuing medical education for periodic (every three years) re-registration of the license to practice medicine. The State of Wisconsin has enacted malpractice legislation that requires continuing medical education credit for relicensure.

The 1974 survey by the American Journal of Nursing discovered voluntary continuing education programs for nurses in twenty-five states; four states have laws which mandate continuing education for nurses; another four states have clauses in Nurse Practice Acts that encourage Boards of Nursing to implement mandatory continuing education programs, and sixteen state nursing associations are planning to take action on mandatory continuing education.

Since 1961-62, the AMA Journal has published an annual listing of courses which are being sponsored/offered in continuing medical education. Currently, this list does not include non-accredited courses or programs. There has been a dramatic increase in the number of courses offered in the last five years, as Figure VI.6 indicates:<sup>17</sup>

FIGURE VI.5. DISTRIBUTION OF AMA-ACCREDITED ALLIED HEALTH EDUCATION PROGRAMS BY STATE, 1976

[illegible]

NOT REPRODUCIBLE

FIGURE VI.6: NUMBER OF CONTINUING MEDICAL EDUCATION COURSES (1961-1977)

Year	Total Number Courses Reported	No. Primary Sponsors	Courses offered by:			
			Medical Schools		Hospitals	
			No.	%	No.	%
1961-62	1,106	206				
1962-63	1,146	208	626	55	404	9
1963-64	1,264	267	760	60	163	13
1969-70	2,016	323	886	44	441	22
1975-76	4,862	554	1,920	40	919	22
1976-77	5,800	660	2,338	40	1,327	23

A further breakdown of continuing medical education activity for the year 1974-75 is provided in Figure VI.7.

One of the most progressive and effective continuing education programs is conducted by the American Academy of Orthopaedic Surgeons (AAOS), which has 8,000 members in the U.S. Its education program has been active since the organization was established, and is subject to constant review and evaluation which serves to modify and develop new course objectives as the demands of the profession change. In 1977, AAOS-sponsored continuing education programs were viewed by more than 11,000 physicians. During the next fiscal year, the AAOS will conduct twenty-one courses for physicians, four for nurses, one summer institute (600-plus people are expected), and one annual meeting (6,510 attended last year).

It is possible that physicians spend more time and money on continuing education than any other professional group. Based on a survey conducted in 1973 by the Iowa Medical Society and the University of Iowa College of Medicine, Mr. Lewis A. Miller has calculated the investment of physicians in continuing education. The Iowa survey found that physicians spend an average of seven hours per week in continuing education activities including journal reading, audio tapes, colleague consultation, hospital conferences, postgraduate lectures and courses, and self-assessment and home-study courses.

*"On the average, the American physician engaged in patient care spends at least 300 hours on his continuing education..... Using the count of 237,500 such physicians, we find that they spent a grand total of 71,101,500 hours on their continuing medical education in 1973." 18*

The opportunity cost, or the revenue that is given up in order to attend classes, was estimated at \$6,000 per year per physician. (The average physician is assumed to earn \$20 per hour, a figure which is multiplied by 300 hours per

FIGURE VI - 7

ACTUAL CME ACTIVITY CARRIED OUT BY INSTITUTIONS  
LISTED BY AMA FOR 1974-75

	<i>No. of Institutions</i>	<i>No. of Courses Actually Presented</i>	<i>No. of Courses Listed By AMA - 1974-75</i>	<i>Total Hours of Instruction Offered</i>	<i>No. of Physician Registrants for all Courses</i>	<i>No. of Individual Physicians Represented in Total Registration</i>	<i>Courses Cancelled</i>
<u>Medical Schools</u>	73	4,004	1,516	63,701	234,982	120,419	79
<u>Hospitals</u>	164	3,074	652	25,795	147,827	41,089	34
<u>City, County and State Medical Societies</u>	13	1,062	84	3,700	58,236	14,119	0
<u>Specialty Medical Societies and Academy of General Practice</u>	129	1,585	1,080	20,309	132,271	71,715	43
<u>Voluntary Health Organizations</u>	13	125	39	2,295	11,364	6,984	11
<u>Other: Schools of Public Health - Post Graduate Medical Schools - Government Agencies</u>	40	334	306	53,974	19,907	16,133	13
	432	10,184	3,677	169,774	604,587	270,459	180

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NOT REPRODUCIBLE

year, the average amount of time spent on continuing education.) This results in a total opportunity cost of \$1,422,030,000 for all U.S. physicians in patient care. The out-of-pocket expense for physicians was projected to be \$94,802,000.<sup>19</sup> The combined total which Mr. Miller estimates is spent annually by physicians for continuing education amounts to \$1.5 billion.

In summary, the total annual investment in continuing medical education is estimated to be:

FIGURE VI.8: ESTIMATED TOTAL ANNUAL COST OF CONTINUING MEDICAL EDUCATION <sup>20</sup>

Investment by:

Physicians	\$1,516,832,000
Hospitals	125,000,000
Medical Schools	8,550,000
Medical Associations	4,000,000
Specialty Societies, etc.	13,000,000
Industry (excluding advertising)	150,000,000
Government	112,000,000
TOTAL:	<u>\$1,929,382,000</u>

In 1976, there were an estimated 961,000 registered nurses in the U.S. At an approximate monthly salary of \$1,000, or \$7 per hour, the opportunity cost for 30 hours of continuing education for nurses (required by 50 states) every two years is \$201,810,000. This is a yearly investment of \$100,905,000 plus an average fee of \$5 per registered nurse per year, for record-keeping. The total yearly investment for continuing education for nurses is approximately \$105,710,000.

The Report of the Continuing Education panel at NASA's October, 1976 workshop summarizes another important consideration in providing continuing education for health professionals:

*"The distribution of health personnel does not necessarily coincide with the availability of continuing education programs. The availability of time to attend such programs is a major consideration. In light of the caseloads for doctors, dentists, and nurses, and in view of the understaffing of many health care facilities, attendance at continuing education classes (particularly for professionals in rural areas who must travel a considerable distance to attend such classes) .....undoubtedly increases the cost of health services."* <sup>21</sup>

#### E. Application of Communication Technology to Continuing Medical Education

It is evident that our nation's investment in continuing medical education is substantial. Application of appropriate communication technology offers the potential of improving access to service, reducing costs, and upgrading quality by:

- .. substituting communication for travel
- .. providing access to programs in rural areas
- .. providing access to highly specialized instruction materials
- .. facilitating compliance with state regulations
- .. improving quality by creating a small number of expensive programs rather than a large number of inexpensive, mediocre programs.

A satellite network for continuing medical education which shows promise is described in Chapter VII, pages VII-12 to VII-16.

Continuing education of the health professional is most effective when the materials are presented in the work environment. Telecommunication technology can contribute to this objective. For example, experiments carried out in Alaska by the Native Health Service, via ATS-1, provided reliable, daily voice consultation between village aides in the Yukon Basin and the physician at the Native Health Service Hospital in Tanana. Prior to ATS-1, some Alaskan villages were completely isolated from the outside for weeks at a time. ATS-6 provided a two-way interactive black and white television system which increased the transmission capacity between the aide and the physician. The tele-diagnosis procedures which were utilized proved to be an effective means of improving knowledge regarding the cause and treatment of disease and injury.

Numerous experiments have demonstrated the effectiveness of television as a modality of education. Learning gains which were achieved via ATS-6 at the University of Washington's regional medical school sites compared favorably with gains which were achieved at the main campus in Seattle. The Veterans Administration had a similar experience. NASA's ATS-6 satellite was used to transmit continuing professional education programs to personnel in ten VA hospitals located in the Appalachian states. The VA experiment demonstrated the effectiveness of using telecommunication technology to deliver instructional programming involving video seminars, patient care presentations, teleconsultations, and computer-assisted instruction.



Despite these accomplishments, communication technology has not been used extensively in continuing medical education. Initially, it was difficult to maintain picture quality; adequately trained technicians were in short supply. However, the factor most responsible for lack of acceptance in the medical community has been the poor quality of the educational materials. Steps are being taken to remedy this deficiency, but high-quality programs are costly. Research in the area has determined several questions which must be answered to successfully implement a telecommunication system for continuing medical education:

1. What programming can best be presented at work? At home?
2. What factors influence the positive outcomes of a telecommunications mediated program?
  - a. Number of participants
  - b. Type of program (content)
  - c. Cost of preparation of programming
  - d. Mode of communication
3. What are the tradeoffs and when does use of telecommunications become cost effective?
4. Who will pay for the programs?

These questions are now being explored by the American College of Physicians (ACP), a national specialty society with a membership of over 30,000 professionals engaged in the practice of internal medicine. ACP is concerned primarily with the provision of quality educational programs and services for the members. This society is currently negotiating with the Lister Hill Center for Biomedical Communications to arrange a satellite mediated presentation, "Meet the Professor," which will be transmitted to one of the ACP regional meetings. In addition, the American Academy of Orthopaedic Surgeons, the Academy of Emergency Room Physicians, and the Academy of Family Practice are negotiating with Lister Hill Center to develop and distribute computer-assisted instruction.

About one fundamental premise, there is little disagreement among educational researchers: students of all ages can learn effectively from television. Godwin C. Chu and Wilbur Schramm first published this conclusion in their definitive study of educational television entitled Learning from Television: What the Research Says (Washington: National Association of Educational Broadcasters, 1967). A review of this same field in 1974 by Dr. Monty Stanford of the University of Southern California concluded:

*"The work of Chu and Schramm (1967) essentially constitutes a definitive treatment of research on instructional television and radio. Some refinements have been suggested by this review, but they are indeed sparse."*<sup>22</sup>

#### F. Validation Process

A panel of experts were interviewed individually to assess their opinions regarding the status, requirements, and prospects for use of telecommunication technology in continuing medical education. Their names appear in Appendix VI.A.

#### G. Conclusion

Cost, access, and quality are the major issues in continuing medical education. But once the requirements of the user are "established," one must look beyond simple utilitarian motives. Through the use of telecommunications, a rural physician may have greater access to programs and services which are now readily available to his urban counterpart, but will he watch the programs? The influence of such variables as the value of one's leisure time, one's aesthetic preferences, and other personal attitudes may prove to be at least as important as utilitarian motives in gaining acceptance.

The other benefits begin with the possibility of providing more leisure time. Use of telecommunications should relieve the time-consuming burden of traveling great distances to take mandatory courses. When available resources are concentrated on a few good continuing education programs rather than spread thinly in support of mediocrity, the physician also should find the experience to be more enjoyable and edifying. The higher quality of the programs and the additional time made available should allow the physician to see more patients, improve the quality of care, and reduce costs to the consumer. The additional time should also reduce pressures on the physician, thereby enhancing relationships with patients, family, and friends.

In the final analysis, the pursuit of pleasure has always been a more attractive activity than self improvement. What may sell this marvelous

system to upgrade continuing education in America are the network radio and television programs which also will be made more widely available. Continuing education is, however, a life-long process. The opportunity is at hand to expand one's view of the world while providing the other amenities of life.

APPENIDX VI .A

PANEL OF EXPERTS

ED ROSENOW, M.D.	Executive Vice President - Retired American College of Physicians Philadelphia, PA
CHARLES HECK, M.D.	Executive Director American Academy of Orthopaedic Surgeons Chicago, ILL
DOUGLAS EASTWOOD, M.D.	American Society of Anesthesiology Professor, Case-Western Reserve School of Medicine Cleveland, Ohio
LEON O. JACKBSON, M.D.	Regenstein Professor of Medicine Director - Ben May Cancer Research Institute University of Chicago
CLIFFORD GURNEY, M.D.	Professor of Medicine Pritzken School of Medicine University of Chicago
J.S. REINSCHMIDT, M.D.	Director, Continuing Education University of Oregon School of Medicine Portland, Oregon
M. ROBERTS CROVER, M.D.	Assistant Dean University of Oregon School of Medicine Portland, Oregon
MARVIN DUNN, M.D.	Assoc. Dean, Medical School University of California, San Diego
MR. LYLE NELSON	Director, Dept. of Communication Stanford University Palo Alto, CA
DR. EDWIN PARKER	Professor of Communication Stanford University Palo Alto, CA

JANNET FOWLES	Dept. of Communication Stanford University Palo Alto, CA
TOM MEYER, M.D.	Assoc. Dean & Director Continuing Education, U. of Wisconsin Madison, Wisconsin
MS. BEA BIGGS, FNP	Family Nurse Practitioner Asst. Director, Dept. of Health State of Idaho
DR. GERALD OPPENHEIMER	Director, Pacific Northwest Regional Health Sciences Library University of Washington Seattle, Washington
C.H. WILLIAM RUHE, M.D.	Senior Vice President American Medical Association Chicago, Illinois
JACKSON W. RIDDLE, Ph.D., M.D.	Director, Division of Educational Policy & Development American Medical Association Chicago, Illinois
CLARKE MANGUN, M.D.	Department of Education American Medical Association Chicago, Illinois
LEO LEVERIDGE, M.D.	Department of Medical Education American Medical Association Chicago, Illinois

CHAPTER VI  
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## CHAPTER VII

### REQUIREMENTS FOR A PUBLIC SERVICE COMMUNICATIONS TECHNOLOGY SATELLITE (PSCTS)

#### A. Introduction

PSSC is about to complete the first year of a three-year initial effort to develop an accurate methodology and data base for projecting telecommunication requirements of public service users. A status report of this study will be provided in this chapter. The sources of information upon which these projections are based are Chapters III through VI of this report, the Public Service Communications Satellite User Requirements Workshops which were hosted by the Goddard Space Flight Center in October 1976 and March 1977,<sup>1,2</sup> and other related information which has been provided to PSSC by miscellaneous sources.

PSSC has attempted to estimate the approximate dimensions of the entire market for public service telecommunications in the first phase of its study. The projections to follow, while speculative, are based on two assumptions: that significant increases in telecommunications utilization will not occur over a five-year period unless:

1. The organization "obviously" will benefit from changing its way of doing business, and
2. The required organizational tremors will be mild.

The public service sector has been partitioned into three categories:

1. Category A - modest institutional adjustments are necessary and significant productivity gains are likely, resulting in "modest" risk to the supplier of telecommunications services. (More specifically, the risk is too high for a common carrier, but "Category A" programs are likely to provide a firm foundation for a NASA-supported Public Service Communications Technology Satellite program.)
2. Category B - the institutional requirements picture shows promise, but more information is needed to assess probable benefits and risk.



3. Category C - major institutional adjustments are necessary, the risks to the communication supplier are high, but the possible benefits are also high. Examples include an electronic mail system tailored to the requirements of the U.S. Postal Service, or a telecommunication/computer system addressed to core curriculum subjects in elementary and secondary education, freeing the classroom teacher to concentrate on individual problems rather than mass problems. Small scale experiments which were addressed to "Category C" problems would be appropriate for inclusion in the PSCTS program, although it may be years before a viable commercial market develops.

The time frame for the projections is 1982, using the best 1976 data available to PSSC. In general, it is assumed that approximately one-third of the total projected telecommunications traffic would be carried by a communication satellite if an appropriate network were available.

The projected levels of telecommunication utilization are based on estimates of what it costs the organization to do a job now -- inefficiently. PSSC assumes, for example, that hospitals should not have to spend 10% of their annual operating budget on record-keeping functions and is attempting to promote increased use of information networks on this basis. PSSC is assuming implicitly, however, that once a hospital commits to increased use of computers and telecommunications, it will begin using the extra capabilities thereby made available to perform new, unforeseen tasks.

#### B. 1982 Traffic Projections for a PSCTS

A macroscopic description of the potential market for public service satellite communications was provided by Walter E. Morrow, Jr., who is director of the MIT Lincoln Radiation Laboratory. Morrow projected an annual demand of approximately \$285 million in response to a presentation by PSSC to the Ad Hoc Subcommittee on Satellite Telecommunications (chaired by Thomas F. Rogers), of the Applications Committee of the Space Program Advisory Council, on April 26, 1977. The basis for Morrow's estimate is as follows. The health sector, education sector, and all other sectors of the public service (principally government agencies) each have annual operating budgets of approximately \$120 billion, or the total expenditure of the public service is approximately \$360 billion. Experience has shown

that organizations of all kinds spend approximately 4% of their total operating budget on telecommunication services, of which approximately 12% is spent on transmission. The total public service market for transmission services, then, is approximately  $(\$360B) (0.04) (0.12) = \$1,728,000,000$ .<sup>\*</sup> Morrow assumed that approximately one-third of the traffic represented by this total pertains to transmissions of more than 100 miles, and that approximately half of this long-distance traffic would be carried by satellite, if an appropriate network were available. Morrow concluded that the potential market for public service satellite telecommunications is approximately  $(\$1.728B) (0.33) (0.5) = \$285,000,000$ .

If one grants Morrow's assumptions, then by 1982 the potential market for a PSCTS will be well in excess of \$300 million at current growth rates.

PSSC's own projections of "Category A" service sectors appear in Table VII.1. The potential public service satellite telecommunications market in 1982 is estimated to be \$167 million. The total required communication capacity would be approximately six video transponders (of which three are already under contract to public broadcasting by Western Union), and perhaps three additional transponders for voice and data.

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<sup>\*</sup> Morrow's "4% for telecommunications" rule is somewhat high for the public sector but the "12% for transmission" rule is somewhat low; so that the resulting estimate based on the product of these numbers is reasonably accurate. The total operating revenues of U.S. common carriers represent approximately 2% of the gross national product (GNP). The equivalent revenue from mobile services and other privately-owned networks add another 1% to this fraction, or telecommunications-related expenditures for the economy as a whole amount to about 3% of the GNP. The "12% for transmission" rule was suggested by Lynn W. Ellis of ITT at the April 26 meeting of the Ad Hoc Subcommittee on Satellite Communications. While such a partitioning of telecommunications costs (88/12) accurately describes ITT's past experience, future use of communication satellite networks in which the terminals are located at the point of use will reduce the contribution of the "local loop" to the total cost of service and increase the contribution of transmission-related costs. If 3% of future public service expenditures were allocated to telecommunications services and 16% of this amount were spent on transmission-related costs, then the resulting projected expenditure level would be unchanged.

Table VII.1. Potential Market for a PSCTS (1982)

<u>Service Sector</u>	<u>Est. Revenue</u>	<u>Est. Volume</u>
American Hospitals	\$76M	$7.0 \times 10^{13}$ Bits/Year
Equipment Maintenance	\$63M	$3.5 \times 10^{11}$ Bits/Year
Knowledge Retrieval	\$15M	$1.8 \times 10^{12}$ Bits/Year
Adult Education/ Public Broadcasting	\$ 8M	6 video channels 4 15 kHz radio channels
Environmental Monitoring	\$ .5M	$4.5 \times 10^{10}$ Bits/Year
Total:	\$167M	Approx. 9 transponders

The assumptions underlying these projections follow.

1. American Hospitals

The problems and opportunities facing the American hospital system are discussed in Chapter III. PSSC has discovered that the two developing trends which are most likely to involve extensive utilization of satellite communications in the U.S. health care system are:

1. The aggregation and sharing of scarce personnel resources, professional and managerial (management information systems for accounting, billing, inventory control, medical records, and emergency medical services); and
2. The aggregation and sharing of expensive clinical technology (clinical laboratory networks, clinical radiological consultation, and multiphasic testing).

What are the implications of these trends to the PSCTS program? American hospitals now spend an average of \$20 per patient per day for record-keeping, an expense which amounted to an estimated \$5.6 billion in 1976, or 10% of the total operating budget of American hospitals. If satellite communications and computer technology could reduce this cost by only 25%, the annual savings would be \$1.4 billion. In three years the total savings would exceed NASA's present budget! Hospitals are at the top of PSSC's list of potential beneficiaries of a PSCTS.

In projecting the dimensions of the telecommunications market in 1982, PSSC makes the following assumptions:

1. The rate of growth of hospital expenditures will stabilize at a compounded annual rate of 9%, as requested by the Carter Administration. (The rate of growth in 1975 and 1976 was about 14%, and the total hospital operating budget was \$55.4 billion in 1976.)
2. Hospitals will continue to spend approximately 10% of their total budget on record-keeping functions.

3. As acceptance of computer-based support services grows, the percentage of the record-keeping budget spent on automation (given that automated procedures are used at all), will rise from a present value of about 12% to 18%.
4. The percentage of the automated record-keeping budget spent on telecommunications will be 15%; and
5. The percentage of telecommunications service provided by satellite will be 33%.

The projected potential satellite revenue is then:  $(\$55.4B) (1.09)^5 (0.1) (0.18) (0.15) (0.33) = \$76 \text{ million.}$

An American hospital performs an average of 62 record-keeping transactions per patient per day. A total of 278.4 million patient-days of service were delivered by American hospitals in 1976. Assuming that the volume of traffic grows at a compounded annual rate of 9%, that 33% of the total volume is carried by satellite, and that the average transaction requires 8,000 bits to encode, the estimated volume is:  $(278.4 \times 10^6) (62) (8,000) (1.09)^5 (0.33) = 7.0 \times 10^{13} \text{ Bits/Year.}$

PSSC has not included the traffic associated with clinical support services in these estimates. CAT scanners and facsimile devices to support radiological functions, coronary care units, devices to monitor vital signs from a remote location, and units which are used in multiphasic testing all will add to the volume of traffic, particularly in rural areas of the country where half of the 7,000 U.S. hospitals are located.

Clinical technology has revolutionized health care, but it is prodigiously expensive. Smaller institutions cannot afford the expensive apparatus that modern medicine requires. (The fatality rate from coronary infarctions is twice as high in rural hospitals, and 70% of the traffic fatalities in the U.S. occur in rural areas, where only 20% of the population resides.) These institutions are being compelled to share facilities or to merge in some fashion with other institutions or to focus on patients whose treatment does not require expensive hardware and specialized personnel. The availability of satellite data communications will reinforce a growing tendency to consolidate health-care delivery throughout a geographic region.

## 2. Equipment Maintenance

Federal and state government agencies have extensive investments in equipment which is dispersed throughout the country. PSSC does not have adequate information regarding the dimensions of this requirement, but preliminary insight may be obtained from the experiences of the Federal Aviation Administration in its VORTAC (Vhf Omni Range Tactical Communications) system.<sup>3</sup> In 1975 the FAA had a total maintenance budget of \$320 million, of which 80% was personnel related. Through use of telemetry and centralization in the VORTAC program, the FAA could eliminate the need for many on-site technicians and spare parts, which would result in a considerable savings. . Studies by the Mitre Corporation indicate that the maintenance budget for the VORTAC program, which amounted to \$38 million in 1975, could be reduced to approximately \$10 million annually through appropriate use of telecommunications.<sup>4</sup>

Use of telemetry, microprocessors, and telecommunications probably could effect tremendous savings in equipment maintenance and load management of various resources (power, water, light, heat, air conditioning, oil and gas pipeline flow, control of traffic lights and vehicular flow, etc.). To gain a tentative estimate of the volume of the associated telecommunications service, PSSC makes the following assumptions:

1. The total investment in capital equipment by public service agencies is \$100 billion, an amount which is growing at 5% annually;
2. Ten percent of this equipment is subject to savings through appropriate use of telemetry and centralized maintenance procedures;
3. The annual cost of maintenance averages out to be 10% of the capital cost of the equipment;
4. In those cases where savings can be effected through use of telemetry, 15% of the maintenance budget is associated with telecommunications service; and
5. One-third of the resulting traffic is carried by satellite.

The resulting projected potential satellite traffic is: (\$100B) (0.1) (0.1) (0.15) (0.33) (1.05)<sup>5</sup> = \$63 million.

The annual bit rate is projected under the assumption that the average cost of this dispersed equipment is \$10,000, that sixteen bits of data and use of frequency multiplexing are sufficient to address and encode the message, and

that each piece of equipment is interrogated every ten minutes on the average:  
 $(1.05)^5 (0.1) (0.33) (16) (6) (24) (364) (\$100B)/(\$10K) = 3.5 \times 10^{11}$  Bits/Year.

### 3. Knowledge Retrieval

Exciting developments in knowledge retrieval are discussed in Chapter V. PSSC observes that progress is likely to occur on two broad fronts in the 1980s:

1. There will be increased acceptance of proven retrieval techniques. The technology is now adequate to meet the clerical needs of the paperless office; and
2. Advances in information technology will extend the state-of-the-art beyond simple reference retrieval to retrieval of data, facts, and -- ultimately -- knowledge.

Requirements to support so-called "technical services" in American libraries (cataloging, serials control, acquisitions, circulation, and inter-library loans) will be projected from the present budget of the Ohio College Library Center (OCLC), which now spends approximately \$2,280,000 annually on leased terrestrial lines to reach 850 libraries in 44 states. PSSC makes the following assumptions:

1. Use of automated services in libraries which already accept the concept will grow from a present level of 3% of the total operating budget to 8% of the operating budget;<sup>5</sup>
2. The number of libraries which use automation will grow at a compounded annual rate of 15%; and
3. One-third of the total telecommunications traffic potentially could be routed by satellite.

The potential revenue in 1982 for technical services is estimated to be  
 $(\$2,280,000) (1.15)^5 (8.0/3.0) (0.33) = \$4$  million.

5,707,828 books were cataloged in the OCLC system in 1976, using an average of 4,800 bits per request. PSSC projects the potential volume of satellite traffic in 1982 to be  $(5,707,828) (1.15)^5 (8.0/3.0) (0.33) (4,800) = 4.8 \times 10^{10}$  Bits/Year.

To gain a qualitative appreciation of the potential demand for information-retrieval services in 1982, PSSC makes the following assumptions:

1. One percent of the U.S. population will interrogate a data base on the average of once a week;
2. The average cost of each search will be \$2;
3. Fifteen percent of this revenue will be related to telecommunications; and
4. Thirty-three percent of the traffic will be routed by satellite.

The estimated revenue is then  $(220 \times 10^6)$  (\$2) (52) (0.01) (0.15) (0.33) = \$11 million.

Assuming that an average of 10 bibliographic records are retrieved with each search, each of which is encoded with 4,800 bits, the potential volume of satellite traffic is  $(220 \times 10^6)$  (52) (0.01) (0.33) (10) (4,800) =  $1.8 \times 10^{12}$  Bits/Year.

The total revenue deriving from knowledge retrieval services is estimated to be \$15 million. This estimate is speculative but could well be low if the "paperless office" is broadly accepted by the public service sector.

#### 4. Adult Education/Public Broadcasting

The Corporation for Public Broadcasting has entered into a seven-year contract with Western Union which provides for the leasing of three transponders at an annual lease rate of \$800,000 per transponder.<sup>6</sup> The agreement calls for eventual activation of a fourth transponder at a lease rate of \$750,000 annually. PSSC assumes that the Public Broadcasting Service and National Public Radio will account for approximately \$4 million of business annually to a satellite carrier (Western Union).

PSSC has been working with public broadcasting in developing non-broadcast applications of this satellite interconnection network. PSSC is interested in using this network to provide continuing professional education and distributed conferences. A description of the requirements appears in Chapter VI. A hypothetical system model for continuing medical education, which uses two-way communications, is developed in Section D. It is assumed in this section that physicians will require the equivalent of \$1.4 million of transponder capacity in 1982. The demands on the system from other professional groups will increase this projected level of utilization by a factor of three.

#### 5. Environmental Monitoring

The National Oceanic and Atmospheric Administration (principally the National Weather Service), the Environmental Protection Agency, the U.S. Geological Survey, the Corps of Engineers, the Department of Agriculture, and the Department of Interior all have extensive requirements for monitoring atmospheric, edaphic, and/or oceanic data. Ecosystems International Inc., under contract to the Goddard Space Flight Center, determined that in 1975 these agencies maintained 90,714 stations in the U.S. having an average of four sensors apiece.<sup>7</sup> The annual cost

of the present operation is estimated to be \$98.3 million and the volume of information is  $1.36 \times 10^{11}$  Bits/Year. Only 6% of these platforms are remotely interrogated at the present time. PSSC conjectures that as cost-effective satellite networks are developed for the equipment maintenance/load control problem, environmental monitoring would contribute at least another \$5 million of business annually. In arriving at this estimate, it is assumed that 15% of the present \$100 million budget should be spent on telecommunications services, of which one-third should be directed to satellite carriers.

#### 6. Other Potential Markets

PSSC does not have sufficient information to evaluate a number of other promising candidates for service. Other possibilities are:

- . Department of Defense training
- . Training of other federal and state employees
- . Law enforcement (fingerprint data, automobile registration and license information, LETS, and NCIC functions)
- . Management information systems for government agencies
- . Search and rescue/disaster relief
- . Voluntary, non-profit organizations<sup>8</sup>
- . Internal Revenue Service, Social Security data transfer
- . Job bank involving the Department of Labor.

It would appear that if these other possibilities were evaluated in detail, potential revenue for a satellite network would exceed \$300 million. It is impossible to foresee how quickly actual demand will rise to this high potential level, however.

#### C. Comments on the Nature of the Traffic

Most previous studies of public service communication requirements have concluded that video applications would predominate. The FCC Broadcast Bureau Service Group on Satellite Broadcasting, for example, projected a demand in excess of 300 video circuits to support requirements of U.S. educational and health-care institutions.<sup>9</sup> PSSC concurs with this projection, which was used to estimate required synchronous orbit-bandwidth capacity in the year 2000. Indeed, six of the nine transponders projected by PSSC to support 1982 requirements are related to video applications. Four of these six transponders already are committed to support public broadcasting.



The projected use of two-way data communications by public service organizations is highly significant, however. Inadequate provision has been made to support uplink requirements of public-service users. PSSC stated in response to the FCC's Fifth Notice of Inquiry regarding preparations for the 1979 General World Administrative Radio Conference:<sup>10</sup>

*"There is a need for uplink capacity to correspond to the present international downlink allocation from 2500 MHz-2690 MHz... The frequency band must be such that the end-to-end service can be provided inexpensively, implying use of a band which is relatively free of terrestrial interference, permitting the terminals to be located at the point of use... In view of the fact that the band 4.4 GHz-4.7 GHz is available internationally to the Fixed Satellite Service as an earth-to-space link, PSSC urges that the present allocation be retained in its present form."*

Presently there is an imbalance of capacity between the uplink and the downlink allocations for the Broadcast Satellite and Fixed Satellite Services in the International Radio Regulations. Approximately 16% more bandwidth has been allocated for the downlink in that portion of the radio-frequency spectrum which extends from 2.5 GHz to 14.5 GHz. It was agreed at the 1971 WARC that the Fixed Satellite Service and the Broadcast Satellite Service would share uplink allocations. In view of the crucial need of the Broadcast Satellite Service to locate terminals at the point of use to support applications of low-cost, two-way data communications, it may be appropriate to re-examine the present understanding. International common carriers typically advocate sharing of uplink capacity with the Fixed Service (terrestrial common carrier). The resultant level of local interference may preclude locating two-way earth stations at the point of use.

To place the required capacity for two-way data communications in perspective, compare the estimated annual levels of Table VII.1 with the capacity which could be provided by a single Satellite Business Systems transponder operating at 50 megabits. Such a transponder has a theoretical capacity of  $1.6 \times 10^{15}$  Bits/Year, almost two orders of magnitude higher than that required to support projected public service requirements. The earth stations which SBS allegedly plans to install have a capital cost of approximately \$474,000.<sup>11</sup> The possibility of exchanging reduced system throughput for reduced earth-station cost immediately suggests itself.

Table VII.2 was suggested by Norman Abramson of the Aloha Systems Project, who is an expert on "affordable" satellite data communications. Abramson advocates use of a packet-switched satellite data communications network, operating at a speed somewhere between one and two orders of magnitude below the SBS network. For concreteness, Table VII.2 assumes a system throughput of 5 megabits, although this figure is arbitrary and not the result of a cost-performance evaluation.

TABLE VII.2

An Affordable Satellite Data Communications Network (Ref.12)

<u>Application</u>	<u>Capacity</u>	<u>Capacity using Low Cost Earth Stations</u>
Continuous Data	50 Mbps $1.58 \times 10^{15}$ Bits/Year	5 Mbps $1.58 \times 10^{14}$ Bits/Year
2-Way Video	1 Conversation	*
2-Way Audio	800 Conversations	80 Conversations
3,000 Word Reports	400 Reports/Sec.	40 Reports/Sec.
200 Word Messages	6,250 Messages/Sec.	625 Messages/Sec.
Interactive		
Computer Terminals	500,000 Active Users	50,000 Active Users

Consider the transmission of 3,000 word reports (roughly 8-to-10 typewritten pages). Such a report can be represented by about 120,000 binary digits. (Ten pages at 300 words per page, five characters per word, and eight binary digits per character.) Since a single SBS transponder is capable of transmitting about 50 million binary digits/second, one could transmit about 400 such reports each second through but one SBS transponder. A typical medical record contains 1,000 characters or 200 words. Six thousand two hundred and fifty such messages could be transmitted each second through a single SBS transponder.

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*\*Two way video would not be physically impossible in this hypothetical network, but the earth stations probably would cost at least \$80,000 apiece. PSSC assumes arbitrarily that the earth stations must cost less than \$20,000 in an "affordable" satellite communications network.*

Consider knowledge-retrieval applications. Professor Abramson notes:<sup>12</sup>

*"Measurements made in the United States show that the average data rate in and out of interactive computer terminals is about 10 bits/second. Then a single transponder, if it could be fully loaded, would be able to support about five million such terminals. Because of the requirement that these terminals be interactive, however, it is unrealistic to assume the transponder channel could be fully loaded. A more realistic assumption would be that we could use the channel at a maximum of 10% of its capacity."*

Whereas SBS terminals will cost about \$474,000, it is likely that terminals optimized for public service record-keeping applications will cost less than \$20,000 in units of 500. Hughes Aircraft has developed such a terminal in prototype form which they would sell in small quantities for \$25,000.<sup>13</sup>

#### D. A Promising Application: Continuing Medical Education

PSSC firmly believes that computers and telecommunications offer enormous promise to public service organizations. An example of the benefits that would be derived from aggregation of requirements and coordinated application of satellite communications may be found in continuing medical education (CME), a subject which is discussed in detail in Chapter VI. The American Medical Association estimates that 270,459 individual physicians out of a total population of 354,000 participated in CME courses in 1974-75. A total of 58,635 physicians had a current Physician's Recognition Award (PRA) as of June 30, 1976, and some 99,200 physicians have qualified for the award at some time during the eight years of the program.<sup>14</sup> To qualify for the PRA, 150 hours of continuing education is required over a three-year period, an average of 50 hours per year. Of the 150 hours, 60 hours must qualify for Category I credit.

The example to be described presumes use of a satellite communication network which provides one-way video and two-way data or voice to 500 terminals. Much of the material to be distributed is pre-recorded, but an important element of most of the programs will be interaction of two generic forms. One form will involve questions from the field, using one of three voice channels which are available for this purpose. (A lecturer plus two assistants will be available throughout the program to field such questions.) A more widely utilized form of interaction will involve use of mark-sense cards and optical card readers, which will be available at each site. Prior to the class, the students will receive study guides which contain a number of questions. The answers to these questions and others raised during the class will be answered in a multiple-choice format and relayed to the

studio during the class. The lecturer and his two assistants will receive a histogram of responses in real-time, which will help to determine what supplementary material to emphasize. Each student's responses will be evaluated in non-real time by computer, and each student will be mailed an evaluation after the course is completed. Although this evaluation will be largely computer-generated, resources in the student's community will be identified to follow up progress made during the course.

Such an elaborate procedure, which is designed to combine the best features of prerecorded lectures, live interaction, and computer-managed instruction, could be profitable to both the student and supplier if enough physicians choose to participate. To provide a realistic example of such a system, PSSC makes the following assumptions:

1. One hundred and thirty-five thousand physicians make use of the network on the average each year (one-half the number which subscribed to one or more CME courses in 1974-75).
2. Participating physicians subscribe to an average of 25 hours of CME programs from the network each year (one half the number of hours required each year to maintain an active PRA).
3. Programs are offered six days a week, 50 weeks a year.
4. Program A will be designed to reach a broad cross-section of physicians. It will be shown every five weeks for 50 weeks, or 10 times a year. It will cost \$20,000 an hour to produce. Fifteen hours of such programs will be produced each year at a cost of \$300,000.
5. Program B will be moderately specialized. It will be shown every five weeks for 50 weeks, or 10 times per year. It will cost \$10,000 per hour to produce, and 60 hours of such programs will be produced each year at a cost of \$600,000.
6. Program C will be highly specialized. It will be shown twice each year. It will cost \$5,000 per hour to produce, and 150 hours of such programs will be produced each year at a cost of \$750,000.
7. Total production cost each year is estimated to be  $\$300,000 + \$600,000 + \$750,000 = \$1,650,000$ . To the degree that the shelf life of each program exceeds one year, the inventory of programs will increase. Included in this production cost is the estimated non-recurring cost of the study guides and the program for the associated computer based instruction.
8. Three hours of Program A will be shown on Wednesday evenings. Three hours of Program B will be shown Monday, Thursday and

Friday evenings and Saturday afternoons.

Three hours of Program C will be shown on Tuesday evenings and Saturday mornings.

9. A total of 1,050 hours of programs will be distributed. These programs will be distributed in three time zones, or 3,150 hours of transponder time will be required. The cost of the transponder time, the video uplink and access center, and the additional bandwidth (if any) needed for the transmission from the field is assumed to be \$400 per hour. The total cost for satellite service is assumed to be  $3,150 \times \$400 = \$1,260,000$  annually.
10. The installed capital cost of the satellite terminals is assumed to be \$22,000 in units of 500. Each terminal is equipped for one-way television and return voice and data. The one-way television will be accompanied by four audio channels, three of which will be used to answer questions. The price of the terminal includes a single color monitor, an optical card reader and data modem, and a microphone, modulator, and separate speaker/earphones for talkback.
11. The terminal will be financed with a 10% loan over ten years. The annual operating cost, including interest on debt service, is assumed to average \$6,000 per terminal or \$3,000,000 for the network of 500 terminals.
12. Three paid lecturers will accompany each course. (Probably there will be several sets of lecturers when the course is offered at several different times.) These lecturers will assist in the development of the study guides, be available in the studio throughout the broadcast, and their principal function will be to answer questions. Assuming the average class meets three hours, the average class size will be 1,071 students. Three separate sound channels will be available to answer individual questions without disturbing the majority of the class. At the lecturer's discretion, a question may be heard and answered over the main (fourth) sound channel. The lecturer and his two assistants, who help to answer questions and interpret the results from the real-time evaluation of the mark-sense cards of the students, are paid a total of \$300 per course-hour, which comes to a total of \$945,000 per year. To bring in the best lecturers, a travel budget of \$420,000 has been allotted. It is assumed that the main lecturer usually will be flown in but that the assistants usually will be local talents, trained in the discipline under discussion.
13. The lecturers work out of a mini studio, which operates at \$300/hr for a total of 3,150 hours. The annual cost is \$945,000. (Although much of the material is prerecorded, the studio either will be "on the air" or in a standby mode throughout the broadcast.)

14. The incremental cost of the post-course evaluation (which will be mailed to each student) is assumed to be \$1.25 per student per course, which comes to \$1,406,250.
15. The cost of promotion and national marketing, which is paid to the medical society, university, or hospital which produces the course (and hopefully secures Category I credit in the process), is assumed to be \$1.50 per student per course, which comes to \$1,687,500.
16. The personnel required to administer end-to-end network service consist of 17 professional people and 7 support staff. The payroll is assumed to be \$600,000. Staff travel for monitoring of program production and terminal maintenance is estimated to be \$100,000 per year.
17. Communication to the site is assumed to average \$100 per site per month, or \$600,000 per year.
18. Local promotion and logistical support will be provided at an average cost of \$5,000 per site per year.
19. Room rental for one small room at each site to view the programs (less than ten people per site per class are expected), is estimated to average \$350 per site per month, which comes to \$2,100,000.
20. Income will be derived exclusively from student fees. Physicians paid an average of \$7.67 per course-hour of high-quality CME instruction in 1976.<sup>15</sup> If half the potential audience would agree to take half the required instruction for the Physician's Recognition Award over this hypothetical satellite network, all expenses would be covered and a slight surplus created if the price per course per hour were only \$6, 28% below the going rate. The quality of the audio-visual materials and the study guides would be much improved. It is conceivable that the quality of the lecturers and interaction would improve as well.

TABLE VII.3. A Budget for a Continuing Medical Education Network.

DIRECT COSTS

Transponder time and access.	3,150 hrs @ \$400/hr	\$ 1,260,000	
O&M of Terminals.	500 @ \$6,000/year	3,000,000	
Studio Operations	3,150 hrs @ \$300/hr	945,000	
Personnel		600,000	
Communications to Site	500 @ \$100/month	600,000	
Staff Travel		100,000	
	Sub Total:		6,505,000

INDIRECT COST

30% of direct cost			1,951,500
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SUB-CONTRACTS

Local Promotion & Logistical Support	500 @ \$5,000/year	2,500,000	
Local Room Rental	500 @ \$350/month	2,100,000	
National Promotion via producer @ \$1.50 per student per course		1,687,500	
Program Production & Support Materials 1,050 program hours per year		1,650,000	
Post-course Evaluation \$1.25 per student per course		1,406,250	
Lecturers 1 lecturer + 2 assistants @ \$300 per course-hr.		945,000	
Lecturer Travel. 1,050 trips @ \$400 per trip		420,000	
	Sub Total:		10,708,750
	TOTAL:		<u>\$19,165,250</u>

INCOME

135,000 students, 25 hrs/student/year, \$6 per course-hr	\$20,250,000
SURPLUS	<u>\$ 1,084,750 (5.4%)</u>

#### E. Required Network Architecture

Synchronous communication satellites have generic properties which make them attractive vehicles for performing certain functions:

1. Broadcasting, which involves the transfer of information from a few points of origination to many receivers, as in a TV or radio network.
2. Archiving, which arises when the spokes of the wheel wish to communicate with the hub, as in a network designed for knowledge retrieval, equipment maintenance, environmental monitoring, or hospital record keeping.
3. Flexible routing. It is possible to allocate the available capacity among the possible routes in the network in an extremely flexible manner. Although the demand for public service satellite communications in 1982 very well may be in excess of \$300 million, the geographical spread of this traffic, the connectivity patterns, and the nature of the peaks and valleys in the load pattern are unknown. The communication satellite could provide a cost effective "toe in the water" to facilitate aggregation of related requirements irrespective of geographic boundaries, thereby reducing uncertainty regarding the nature of the demand for public service telecommunications.

Virtually all commercial satellite networks in existence today are being used as replacements for point-to-point terrestrial links. In a network which is composed of many point-to-point links connecting a large number of nodes, such as the Bell System's Direct Distance Dialing Network for message telephone service, it is not economical to connect every node to every other node. Rather, the messages are routed through a hierarchy of nodes, using expensive switching machines to provide the necessary connectivity. When the application calls for direct connection of nodes, as in broadcasting or archiving, the additional links and switching machines of a hierarchial network add unnecessary cost, complexity, and noise to the system.

Norman Abramson observes:<sup>16</sup>

*"The natural structure of satellite communications links does not require the establishment of point-to-point communications channels in the traditional sense. A more natural form for satellite communications resources is a broadcast structure, allowing each network node*



*to communicate directly with every other network node. The communications architecture which best matches the broadcast structure of the satellite communications channel is therefore one which starts from the premise that communications can proceed from many transmitters to many receivers in a communications environment analogous to that of a multi-person conference. And in the case of data communications it is possible to implement such a broadcast architecture using small earth stations."*

If there are  $n$  earth stations connected to a given satellite, the minimum number of point-to-point channels required so that every station is in one-hop contact with every other station is:  $(n)(n-1)/2$ . A network of 500 stations would require 124,750 channels, which is unmanageable. Professor Abramson is a proponent of packet broadcasting, which utilizes the inherent broadcast nature of satellite transmissions. Rather than build a switchboard in the sky, which connects a number of spot beams that illuminate distinct geographic areas, the satellite could provide a beam which encompasses the full geographic area. All stations would receive each transmission and would be equipped with micro-processors to decode the packets of information intended for them.

Available network synchronization techniques for packet broadcasting are capable of achieving theoretical multiple-access efficiencies ranging from 16% to 90%.<sup>17-20</sup> PSSC has not performed systems engineering studies to determine which of the various access protocols would be cost effective for a public service communication satellite.

#### F. Suggested R&D Agenda for the PSCTS

In view of the fact that telecommunication services tend to account for only about 10% - 15% of the end-to-end cost of an information service, PSSC cautions against myopic attention to the details of transmission, or specifically the characteristics of the communication satellite. While these elements of the problem are extremely important, they should be viewed in the context of the overall problem, which begins with an accurate description of user requirements.

PSSC suggests that national R&D priorities in space communications should place increased emphasis on systems analysis to drive down the total end-to-end cost of information services. What are the tradeoffs among the cost elements of the communications and computer apparatus? What are the tradeoffs between system performance, user acceptance, and system cost? In those elements of the process which must be regulated, what is the relationship between cost and price? What should this relationship be?

Other observers who are more qualified than PSSC have recommended that NASA pursue specific developmental programs to maintain the position of pre-eminence of the U.S. telecommunications industry. PSSC concurs in the recommendation of the Committee on Satellite Communications of the Space Applications Board (of which PSSC's John Witherspoon is a member) that NASA conduct technical R&D in the areas of:<sup>21</sup>

- . High-gain Antennas
- . Precision Antenna Pointing
- . Multibeam Satellites
- . Multiple Access and Network Control Techniques
- . Frequency Sharing Techniques
- . Prime Power Generation
- . On-board Switching
- . Advanced Modulation Systems
- . Low-Cost Earth Terminals for High Volume Production
- . Space Environmental Effects
- . Propagation

#### G. Conclusion

PSSC strongly endorses the proposed Public Service Communications Technology Satellite program. The program is worth doing, and NASA is the logical agency to assume the point position.

## CHAPTER VII

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## CHAPTER VIII

### SUMMARY AND CONCLUSION

Three needs recur throughout the public service: improved access, cost containment, and maintenance of quality. The appropriate application of communication satellite systems could ameliorate each of these concerns. Indeed, low-cost communication is a prerequisite of organizational arrangements which depend upon the substitution of communication for transportation to achieve higher efficiency. Rural America would be the logical place to begin using satellite communications systematically to improve public service delivery and productivity.

Increased use of computer and communications technology could improve health services by:

1. Increasing consumer awareness of health hazards via mass radio and television. Satellite distribution could be especially useful in rural regions of the nation which presently do not have access to public television.
2. Improving access to primary, secondary, tertiary, and restorative services by enabling the provider to maintain his linkage to institutional sources of support, regardless of geographic location.
3. Helping emergency medical services maintain voice contact with distant institutional support systems, regardless of local terrain.
4. Reducing the clinical risk of referring patients to their homes by providing physiological monitoring.

The two developing trends which are most likely to accentuate utilization of telecommunications in health care are:

1. The aggregation and sharing of scarce personnel resources, professional and managerial (management information systems for accounting, billing, inventory control, and medical records, and emergency medical services); and
2. The aggregation and sharing of expensive clinical technology

(clinical laboratory networks, clinical radiological consultation, and multiphasic testing.)

In time, the flow of paper will be replaced by the flow of electrons as we place increasing reliance on communication and less on transportation. The possibilities inherent in using digital computers to support knowledge retrieval have been known for over 15 years. Developmental efforts have been slowed by the fact that computers were too slow, too expensive, had too little memory, and were too little appreciated by the general public. Each of these barriers is gradually being overcome, and by 1985 there probably will be widespread acceptance of the "paperless office" and increasing interest in actual knowledge retrieval, rather than present-day source retrieval.

While libraries are slowly incorporating automation into their working routines, the most likely beneficiary of advances in knowledge retrieval -- the community library -- is least informed about the state-of-the-art. A careful needs assessment of the community library and demonstrations of the efficacy of information networks would foster understanding and increase acceptance of information technology in the library community.

PSSC is less sanguine about prospects for telecommunications utilization in elementary and secondary education. Communication satellites probably will not be utilized effectively by the educational community in the absence of fundamental organizational changes. Productivity gains, however, are absolutely essential; and federal funds are available to implement broadly based demonstrations of new organizational procedures if agreement on a developmental plan could be reached between participating agencies. PSSC has evaluated six promising areas for initiating system-wide innovation but is not prepared to prioritize these alternatives or to suggest a single point of entry to the educational system. There is a need for further discussion among potential users and sponsors to establish priorities.

There is general agreement that the demand for continuing education

is rising, but it is difficult to project telecommunications utilization. Continuing education is a cottage industry. It traditionally has been provided by colleges and universities and by hospitals and other employers to a local market. The advent of low-cost, end-to-end service by communication satellite will permit resources to be shared and higher quality programming to be produced. Most importantly, it will broaden access to materials which are essential to combat career obsolescence.

In 25 years the adult education market very well may be the largest user of wideband communication satellite networks. In the next five years, however, the rate of acceptance may be slow as the traditional purveyors of continuing education materials adjust to the idea of sharing materials in a national network. PSSC is convinced that "the numbers will come out right" if key resources can be aggregated. (See Table VII.3) NASA leadership will accelerate a desirable evolutionary development.

The potential demand among public service users for communication satellite services in 1982 may be in excess of \$300 million. The present risk, however, apparently is still too high for an established carrier to invest venture capital. An appropriate initiative by NASA in space communications R&D would both contribute to continued U.S. technical preeminence in space communications and would also stimulate necessary institutional R&D among public service users to increase productivity and establish a firm basis for new operational telecommunications services.

In conclusion, Americans are entering a new era. Computers and communications will revolutionize the fundamental process of cognition, permitting a much higher percentage of Americans to approach their full potential. The powerful tools of the Age of Information can contribute enormously to economic development and the quality of life. Public service users, however, have difficulty coordinating their actions when the projects under consideration cross institutional boundaries. NASA leadership, in conjunction with the supporting efforts of other government agencies, the aerospace community, the common carriers, and the user community, is necessary to obtain a proper dividend from the people's investment in space.